PROCEEDINGS

OF THE

102nd ANNUAL CONFERENCE

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION

1997

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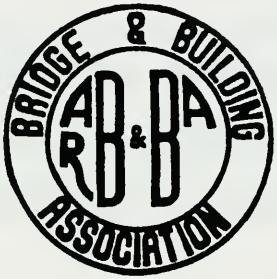
Proceedings of the
102nd Annual Conference
of the

American Railway Bridge and Building Association



Held at the

H. Roe Bartle Hall Convention Center

Kansas City, Missouri

September 7 – 10, 1997

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18154 Harwood Avenue
Homewood IL 60430
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In Memoriam

William H. Huffman

President 1957-1958

Vice President 1953-1957

Director 1951-1953

Deceased April 5, 1997

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JOINT SESSION

Monday, September 8, 1997

Opening Remarks

President Russell: Good morning. As president of the Roadmasters and Maintenance of Way Association of America and on behalf of the American Railway Bridge and Building Association, I declare the 109th annual conference of the Roadmasters Association and the 102nd annual conference of the American Railway Bridge and Building Association to be open and in joint session.

Before we begin the presentations, I think we ought to go over a few safety items. Number one, as you can see there are exit signs over the door. We are in the Conference Center and there are escalators and stairways to the outside. If there is a need for any first aid, there is a first aid station on level three near the entrance to the Exposition Hall. Also if for some reason we would have to leave the room, please do so in an orderly fashion. Exit quickly and with as little difficulty as possible. Another thing I would like to mention is as you go to the outside exhibits at the Norfolk Southern Yard, we encourage you to take the buses and not drive any automobiles. Parking is very limited. It is also a live yard where we have to cross tracks. All of you are railroaders here, but we need to keep in mind that you will be in a live yard so pay particular attention to train movement. Thank you.

I want to welcome each and every one of you here today and thank you for your participation and support for both these organizations. This year promises to be a history maker because this morning we will vote on the proposed merger. If you didn't mail your ballot and you would like to vote in person, we have a gentleman by the name of Mr. Lange Johnston here from Corporate Election Services. He is right outside the door here. You can get a ballot from him if you have not voted already or if you need to change your vote. There will be a presentation on the merger at 11:45 this morning, but for right now we are going to go ahead and begin the conference.

For information, our advance registration was over 1,300 in addition to 248 spouses. Yesterday, with people walking in and registering on site, the total right now is 1,625. So it looks like we are off to a good start. If you remember at the Denver show we totaled up somewhere in the neighborhood of 2,000; so I would imagine by the close of the session today and tomorrow we will be very near what we had in Denver.

As is tradition over the last few years we have been handing out survey forms. I know everyone gets survey forms in their mail at home and every place else and I know they are kind of a pain, but I would appreciate everyone filling out those forms. It is good feedback for the association. We do look at these survey forms to try and get what you want to see presented in the future programs. So as soon as the presentation is completed, please fill out the survey forms and give them to any of our directors. These are the guys running around here with the little tags on. We do keep the survey forms and tally them.

At this time, it's proper to pause for a little divine guidance. This morning we have past president Ken Koff to give the invocation.

INVOCATION

Kendall Koff

Past President
Roadmasters and Maintenance of Way Association.

Thank you, Wayne. I ask you to bow your heads. Dear Heavenly Father, we thank You today for this time in which we gather together here in Kansas City. We ask You for your guidance throughout this conference to guide and strengthen our speakers and presenters and grant them wisdom and confidence as they share their knowledge. We pray for growth in our knowledge through our participation, Lord. Grant us safety in the operation of our various companies that they may be uneventful in our absence. Lastly, Lord, grant us safety in our travels that we may return home to our families without harm. We ask this in Jesus' name. Amen.

President Russell: Thank you, Kendall.

At this time I would like to introduce the board of directors of the Roadmasters Association. As I call their names and they stand to be recognized across the front, I would appreciate all the applause being held until the last director has been introduced.

Our first vice president is Mr. Ron Poulsen, senior project engineer, HDR. Our second vice president is Mr. Darrell Cantrell, engineer of track, Burlington Northern Santa Fe. Our treasurer is Mr. Pete Murgas with Norfolk Southern. Pete was unable to attend due to other business.

Our directors include Mr. Bob King, manager of track maintenance, Canadian Pacific Railway; Mr. Reuven Shiloh, assistant chief engineer planning and support, Conrail; Mr. Dwight Clark, director of engineering quality management, Union Pacific; Mr. Bob Davis, director of track maintenance with Union Pacific. Bob was not able to attend due to problems out on the Mojave. We also have Mr. Tom Long, manager of engineering services, Indiana Harbor Belt; Mr. Joe Riley, engineer standards and quality control, Metra; Mr. Dave Griffith, assistant division engineer, Norfolk Southern; Mr. Chris Dodge, vice president and chief engineer, RailTex; Mr. Andy Sensing, engineering superintendent, Illinois Central; Mr. Gordon Basra, superintendent track evaluation, Canadian National Railway; Mr. Bill Ross, track maintenance superintendent, Canadian Pacific Railway; and Mr. Bob Hunt, division engineer, Conrail. You may now applaud. (Applause) .

Gentlemen, I thank you for your support and efforts that you have given us over this last year. I know it has been a trying year with the merger and everything else, but you have done a fantastic job and I really appreciate it.

I would also like to take a moment right now to recognize Mr. Andy Sensing and Mr. Tom Long who are our programs directors this year. These are the guys who have to chase everybody to make sure that their presentation are ready and on time. This involves a billion phone calls and playing phone tag and I know it's very frustrating. I really appreciate your efforts.

At this time, I want to turn the podium over to Mr. Joe Lileikis, President of the American Railway Bridge and Building Association.

President Lileikis: Thank you, Wayne. As president of the B&B Association, I would like to add my welcome and thanks to all of you in attendance here.

At this time, I would like to go ahead and introduce the board of directors for the B&B Association. When you come up, follow the roadmasters and do what they did, but just this once. (Laughter) .

Senior vice president is Mr. Bob Carter, manager of public programs, Burlington Northern Santa Fe. Junior vice president is Mr. Dave Franz, bridge engineer, Kansas City Southern. Junior vice president is Mr. Jimmy Neece, supervisor facilities maintenance, CSX.

Our treasurer is Don Lewis, assistant engineer structures, Illinois Central.

Our directors are Pat Barrett, engineer construction and maintenance, BNSF; Dave Cook, superintendent B&B, Montana Rail Link; Dick Dummar, manager architectural design, Union Pacific Railroad; Richard Calhoun, associate, CTE Engineers; Willie Benton, engineer structures, Norfolk Southern; Bill GeMeiner, manager methods and research, Union Pacific; Steve Ross, senior structural inspector, Conrail; Gordon Davids, bridge engineer, FRA; and Preston Sargent, manager mechanical systems design, Union Pacific.

This is our B&B board. (Applause) .

Dave Franz, Bob Carter, and Jimmy Neece were instrumental in putting the program together so I want to thank them for their efforts.

At this time, I would like to turn the podium over to Phil Ogden, president of the AREA.

President Ogden: Thank you, Joe. Good morning again. On behalf of the AREA membership and its board of directors, I would also like to welcome everyone here to Kansas City. Wayne Russell, Joe Lileikis, and their organizations, the Roadmasters and the B&B Association and their membership have put together a good technical program for us. I believe you will find the programs interesting, useful, and of value as we all seek continuous improvements into safety of our operations and the efficiency of our operations back at our respective companies.

As you know, a conference like this just doesn't happen. Wayne, Joe, and their members have spent many hours in preparation for a variety of subjects that they will cover with us in the next two and a half days. So listen, and show our support for them by being present for the technical presentations. Running concurrently with the technical conference is the REMSA equipment show. Time has been set aside so that you can participate in both and we encourage you to do so. REMSA has assembled an impressive display of equipment. This requires a considerable effort on their part and we need to support the exhibits by visiting with all the vendors. While there, explore whether or not the equipment, tools, and products on display will help us to do a better job. If not, let them know what you need.

Bob Madderom will have more to say as president of REMSA about the show, but there is one other subject that I want to mention that is important to all of us; that is safety at the outdoor exhibits as Wayne mentioned earlier. These exhibits are in Norfolk Southern's North Kansas City yard. This is an active switching yard. It's a live yard with live traffic on both sides of the exhibits. To get there you have to cross the main line of the Burlington Northern and the Norfolk Southern. We do have a watchman posted, but we should go in there expecting trains at any time. As Wayne said, we are all railroaders and we know how we have to stay alert as far as expecting train traffic.

The parking there is limited. There is a service road into the yard that the Norfolk Southern employees use and everyone else who has a need to be there during normal business hours. So the only people who will be allowed to park there are those who have been given a special pass. Everyone else will have to ride the shuttle buses that REMSA has provided for us.

With that said, again, welcome to Kansas City. I hope that you enjoy your visit and find the next two and a half days useful and enjoyable. Thank you. (Applause).

President Russell: Thank you, Phil. Next, I would like to introduce Mr. Bob Madderom, president of the Railway Engineer and Maintenance Supply Association. As everyone knows REMSA has arranged for the exhibition on this level as well as the show out in the yard as Phil just discussed.

President Madderom: Thank you, Wayne, and thank you, Joe, for your invitation to be here this morning and good morning to all of you. I indeed want to welcome everyone to

Kansas City and especially to Expo 97, an exhibition of maintenance of way products, services, technology and equipment that we believe will carry you into the new century. Of course, the exhibits are right around the corner and down the hall. I think you already know where they are.

Kansas City is a great place with a wonderful history. They tell me that this once cattle town now has more fountains than any city in the world except Rome. I am not going to compare it to Rome, but it is actually a beautiful city and I know you are going to enjoy it. The rivers you will see here are the Kansas River and the Missouri River and the town is actually located at the nexus of those rivers. We know you will enjoy the city and we hope you will enjoy the conference and the exhibition.

While this technical gathering may be the last one exactly as it has been in the fall of the year for many years, none of us have spared any expense or detail to ensure that everything is exactly right for you – the railroader and the railroad supplier. REMSA is offering an excellent display of its members' wares with 184 exhibitors here in Bartle Hall and 30 exhibitors out on track at the North Kansas City Yard. Of course, the Roadmasters and B&B people always put on good technical conferences. AREA's round table has been meticulously planned as well.

Wayne, Joe, and Phil, REMSA is proud to be a partner with you in this endeavor this year and, of course, into the future. I can't say enough about the kindness of the Norfolk Southern Corporation and the cooperation in putting this event together. They leased us several tracks in the North Kansas City Yard for two weeks. It takes a while to put all of that together and they were absolutely cooperative.

As Phil said, this is a very active yard with heavy traffic all the time so you can imagine to what lengths they had to go to accommodate REMSA. It's no small feat. John Farmer was responsible for our being able to use the yard and we thank John for that. The gentleman whom we had been working with consistently on the ground is Tim Czahor, superintendent of terminals. He has been working out all the details from the Norfolk Southern side and, as I said, it has been no small feat. Tim has a regular job to do and needs to keep everything flowing and make it safe for everybody out there. So we thank Tim for his support and efforts also.

As a reminder, the exhibition is open until 5:00 p.m. today and tomorrow and until noon on Wednesday. Exhibits are open all day and we hope you will visit them after your conference session is complete. We have shuttle buses running continuously from the Convention Center to the outdoor yard. We have buses on the green route. You know green is go if you want to go further. Therefore, if you want to go out to the yard, it's the green route. They depart from Lobby 400 basically right in front of where you register. Don't confuse those green bus routes with the red bus routes. Red means stop if you have had enough and you want to go back to the hotels. The red buses can also be picked up right out front of the Conference Center.

We also don't want you to forget about the REMSA reception which is planned for 6:15 p.m. Tuesday evening at the Westin Hotel in the Century Ballroom. Registered railroaders and their wives are REMSA's guests and we would hope that you will stop by for a few minutes to visit with your friends. It's a good time for all. The railway suppliers who are participating can purchase tickets from the REMSA booth in the registration area.

REMSA chose "Gateway to Your Future" as our theme for Expo 97 because we know the railroad industry needs quality services and equipment to have an efficient system, to do their jobs well, and to compete against the ever-after-us trucking industry. We look at Expo 97 as a gateway to more efficient and high-technology machines, systems, and services – the things you will need for greater productivity and greater safety. I encourage you to communicate and negotiate, to build safer, stronger and more efficient railroads. The REMSA companies are here this week to help you with that. We see you as partners. We encourage you to work with us diligently and give us direction. Tell us where you want us to go. We are proud to be able to offer you Expo 97 and we are proud to be here today. Thank you. (Applause).

Wayne Russell, Joe Lileikis, Phil Ogden and Bob Madderom.

President Russell: Thank you, Bob. We truly appreciate the hospitality and the fine exposition that you are putting on here.

At this time, we will again make the same announcement you will hear all morning long just about every hour. It's part of the procedure we have to go through on this merger vote, so I'll do it again for those individuals who may have joined us since we started at 8:00 a.m. If you have not previously submitted your proxy for the merger vote to be held here today at noon and you wish to vote, please see Mr. Johnston who is seated outside of this room. He will give you a ballot. That will have to be done before 11:45 this morning. That is when we will have our joint business session and the vote on the merger.

At this time, I would like to turn the podium over to Mr. Andy Sensing, our program director, so that we can get into the technical part of the presentations for this morning. Thank you very much.

Mr. Sensing: Thank you, President Russell. It's my pleasure to introduce Dave Hesterman, assistant vice president of line maintenance north on the Burlington Northern Santa Fe, and Randy Poggemiller, vice president of Herzog.

Dave Hesterman was appointed to his current position of assistant vice president line maintenance in October of 1996. He is responsible for executing the day-to-day maintenance activities in the northwest portion of the BNSF system. Dave began his career with the Burlington Northern Railroad in 1972. He advanced to track foreman in 1973. In 1975, he was appointed assistant roadmaster. Dave assumed the position of district roadmaster and later was promoted to manager of the region gangs. In 1986, he was appointed to assistant superintendent of maintenance. Dave advanced to region maintenance engineer in 1988. In 1991, he was appointed director of track maintenance, and in 1992, Dave became director of work programs.

Dave is a member of the Roadmasters Association and attended the University of Nebraska.

Randy Poggemiller is vice president railroad division of Herzog Contracting Corporation and is responsible for marketing activities, equipment purchases, custom construction and maintenance projects, site visits, pricing, cost control, and labor contracts. Prior to joining Herzog, Randy worked for the Rock Island Railroad from 1964 to 1975. He began in the operating department and held various positions in Colorado, New Mexico, Kansas, and Missouri.

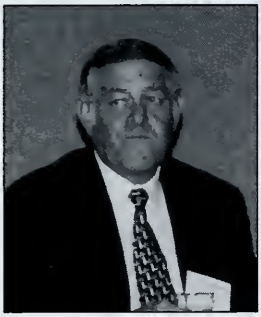
Randy earned a Bachelor of Science degree in business administration from Missouri Western State College. He is a member of the Roadmasters Association, Bridge and Building Association, AREA, REMSA, and NRC.

These two gentlemen had the challenge of dealing with the Stampede Pass last year. Gentlemen, I know you have an outstanding presentation, so at this time I introduce Dave and Randy.

REOPENING OF STAMPEDE PASS

Randy Poggemiller

Vice President
Herzog



Dave Hesterman

AVP Line Maintenance - North
BNSF

Mr. Hesterman: Thank you, Andy. Ladies and gentlemen, good morning. At the conclusion of my presentation, we will open up for any questions that may be generated throughout this presentation.

One legend says that Stampede Pass, which cuts its way through the Cascade Range in Central Washington, got its name from the stampede of trail cutters leaving the Pass in a hurry because they were either overwhelmed by the work or didn't like their foreman. Stampede Pass seemed to have that kind of affect on people.

Stampede Pass was actually one of several passes considered by engineers with the Northern Pacific railroad looking for a path to the Pacific Coast. Stampede Pass was selected in 1881 by assistant chief engineer V.G. Bole. Soon after, railroad engineers recognized that the grade through Stampede Pass was going to call for a tunnel about two miles long at the elevation of over 2,800 feet. The successful bidders on the tunnel project were brothers Nelson and Sidney Bennett who underbid many experienced contractors by as much as 50 percent. The brothers agreed to complete the contract in 28 months by June of 1888 or pay a hefty penalty of over $100,000. In 1885, the NP began building temporary track over the crest of the Cascade Mountains. This temporary switchback would serve the company until the tunnel was completed.

The Bennett crew began hand drilling the 9,850 foot tunnel at an altitude of 2,837 feet in February of 1886. The average excavation rate with hand drills was three and a half feet per day. Some days the job advanced only inches. The air drill was invented while construction was underway and helped increase that excavation rate to six feet per day.

On May 3, 1888, the two ends of the Stampede tunnel were joined when a dynamite blast opened up a fist-sized hole. Three weeks later on May 27, just ten days before the contract deadline, the first train passed through Stampede tunnel. The efforts resulted in what was one of the most remarkable engineering feats of the day.

A high price was paid for the achievement however. Seventeen men were killed while working on the tunnel construction. A total of 39 others were seriously injured.

Diminishing volumes and decreasing demands for rail freight transportation led Burlington Northern to take the Stampede Pass line out of service in the early 1980s. Burlington Northern had two other good routes through the State of Washington through Steven's Pass and along the Columbia River which had been developed by BN predecessors, the Great Northern, and the Spokane, Portland, and Seattle.

In 1983, the eastern part of the Stampede Pass line was sold to shortline Washington Central, but in the early 1990s traffic in the Pacific Northwest started to increase. By 1996, it became clear that the Burlington Northern and Santa Fe Railway needed additional capacity in the Pacific Northwest. BNSF's two routes to the northern Pacific Coast were pretty well saturated with business. Capacity increases were needed to enable BNSF to tap the market's full potential and provide routing alternatives when weather or other operating difficulties interfere with smooth operations.

In April 1996, BNSF announced plans to acquire the Stampede Pass route from the WCRC for approximately $40 million in BNSF common stock and cash. The acquisition involved adding 200 miles of shortline between Kennewick and Cle Elum, Washington, including branchlines and an 85-mile segment from Connell to Moses Lake, Washington.

The challenges posed by the task of reopening Stampede Pass were not quite as great as those challenges faced by the Bennett brothers, but they came close. In early May 1996, BNSF engineering officers representing signal, telecommunications, track maintenance, structures, roadway equipment, maintenance planning, and engineering construction made several hi-rail trips to review the condition of the line, identifying work to be done, and developing a work plan. Prospective contractors joined them on some of these trips to help them prepare bids.

BNSF officials and contractors alike recognized that they had their work cut out for them. Although the western side of the line had been periodically patrolled, mud slides and water from the winter floods of 1995 and 1996 washed out tons of dirt, ballast, and wooden ties under large section of track. Debris had buried culverts and in places boulders covered the rails. During one of our inspection trips, the ice was so thick off one of the Stampede tunnel portals that we could not get into the tunnel. The snow sheds at Stampede tunnel had long been destroyed by fire.

At the time of construction, the eastern portion of the line was still owned by the WCRC, a non-unionized shortline. The work to be done was staggering. With winter weather not far off, every day was precious. Contractors were called in and performed most of the construction work. This flexibility proved to be critical. Initial efforts with the BMWE exploring to use more BNSF maintenance-of-way employees was unsuccessful. Using BNSF forces for this first part of line would have drained manpower across our system and would have undermined the railroad's ability to complete other crucial capital projects also underway at the time. As it was, approximately 250 BNSF employees were utilized on the western end of the Stampede Pass line on strategic work program activities.

Herzog Contracting was awarded track work and 14 other contractors and consultants were identified for related work. The challenges they faced fell short of those by the Bennett contractors 100 years ago, but the challenges were still substantial. Herzog and other contractors quickly mobilized additional inspection trips to help them focus on the task. What under most circumstances could have been an 18-month construction project, this needed to be completed in about six months to meet the rapid volume increases BNSF was seeing. The bulk of the construction work began in July and over the six months that followed approximately 1,100 people, both BNSF and contract forces, labored over 800,000 manhours to complete the task. The entire route was upgraded with the 77.9 mile segment over the Stampede Pass receiving the most attention.

Mr. Poggemiller: I'll recap a few key statistics just to indicate something about the magnitude of this project. More than 5,000 carloads of ballast and riprap were unloaded using Herzog radio control dump trains, company service air dumps, and conventional cars. Nine sidings were constructed or extended equally 22,200 track feet. Eight set-out tracks and two Ys were built requiring the installation of 40 turnouts or track switches. Forty-seven miles of new continuous welded rail was relayed. The rail is 136-pound rail section, CWR on curves transitioning to 132-pound existing rail on the tangent track. More than 1,900 field welds were made using Holland in-track welders and Orgo-Thermit and RailTech Boutet thermite welds.

A full 114 miles of jointed rail was slotted and tightened and 800 rail joints were eliminated.

Portec and railroad forces installed 61 Portec rail lubricators. A total of 145,000 concrete ties provided by CXT and Rocla were installed with a Herzog leased P-811 operated and maintained by Fairmont Tamper. Also, a total of 165,000 wood cross ties and 2,600 wood switch ties were installed by both Herzog and BNSF tie gangs. Track inside the tunnel was completely replaced using a modified track laying machine – the first time such a machine had been used in a tunnel on the BNSF. Sixteen bridges were upgraded or rebuilt and buildings for maintenance of way and trainmen were constructed at seven sites. New crossing services were installed at 57 grade crossings. Active warning devices were installed or upgraded at 46 crossings. Five microwave and radio towers for dispatch and data communication were erected. Electrical service was installed at 80 locations to allow for signal, communications, and building work.

As anticipated, there were numerous challenges that came with a project of this magnitude. Restoring the line was complicated, of course, by the logistics of working on a mountain with a grade of up to 2.2 percent and curvature of up to 10 degrees 31 minutes. Tons of equipment and track materials had to be moved to remote job sites. On each slope, men, equipment, and vehicles were brought up to the tunnel and worked downhill. For equipment like the P-811 this required materials to be brought up nightly and switched behind the machine.

On the east slope of the Pass, vehicles had to travel a nine-mile logging road from the highway to access the line. The west slope was accessed by rail or via 37 miles of logging road. Before the project was over, crews on both slopes were plowing snow off the roads daily to maintain access.

In addition to logistical issues, we also faced environmental issues. Twenty-one miles of the project from Palmer Junction to Lester ran through the Green River Watershed. This area is the water supply for the City of Tacoma, Washington. Understandably, it is environmentally sensitive and access was allowed only for logging and railroad uses by rail or by logging roads that run through the watershed and is monitored through gates. Additional permits and precautions were required to operate in the watershed area including procedures for containing fuels and oils, contingency plans for machine failures, and facilities for containing waste and refuse.

As it turned out, the project was completed without an environmental mishap of any kind even though numerous persons with many consultants and contractors accessed the area.

The weather brought many additional challenges ranging from fire to ice. Dry summer conditions combined with notable Ellensburg winds made for a high fire hazard through much of the project area early on. Several grass fires occurred, some attributable to the track work. BNSF worked with Herzog and local and county fire marshals and officials from the Washington Department of Natural Resources to outline and implement fire protection.

Winter came late on the Cascade Range, but when it came, it quickly made up for lost time. Snow began falling in late October. Then in November, all points along the route received twice their annual average snowfall in one month. December set an all-time record for Stampede Pass with 232 inches of snowfall – that's 19.3 feet. During one week of heavy snow, Herzog mobilized all of their employees to Easton to shovel snow so that the partial siding could be completed.

Due to work on the snow sheds and track rehabilitation in the tunnel, we were unable to pass equipment and materials through the tunnel during the construction. Work on each slope of the Pass was handled as if we were handling two long stub tracks with different strategies and work schedules for east and west slopes of the Pass. At least 200 feet of snow shed needed to be built by early December or ice would form on the track from the waterfall spray at the east part of the tunnel. The construction of the snow shed and work on the tunnel line at the east portal of tunnel three was hindered by a rock slide in October. This prevented workers from pouring concrete until the slide could be excavated. More than 200 rock bolts were required to stabilize the slope to continue working on the adjacent snow shed.

In addition to all the challenges posed by the weather and the terrain, the entire effort needed to encompass the work of 15 contractors and consultants as well as the operation of the WCRC. Consistent track standards were identified and communicated to all involved. Two senior field supervisors were brought in to coordinate efforts, work with local officers, and supervise the roadmasters on site. These two officers had significant field experience with varied work groups and track rehabilitation and construction. They helped coordinate the work of multiple contractors through adjacent areas. These officers also worked daily with officials from the WCRC. Construction progressed on the WCRC under a right of occupancy. The WCRC was sensitive to construction needs, but also needed to maintain their customer commitments. Motive power was provide by BNSF as WCRC had limited resources to lend to the project. Numerous meetings and data communications were necessary to limit service interruptions to WCRC and ensure safety during construction activities.

Working with contractors on such a large project posed three unique challenges: First, the work had to be clearly identified. When BNSF performs its own capital work, the roadmasters and foremen supervising the work know BNSF's track standards and expectations. A lot of what we considered to be standard practice is taken for granted. The contractors were very capable of meeting or exceeding our standards, but because standards and expectations vary so much from one client to the next, our expectations had to be communicated clearly to avoid misunderstanding.

Second, we needed to bring in 10 roadmasters with capital project experience to secure track authority, provide protection from train and other track activity, and inspect quality for contract crews. These roadmasters were required seven days a week, arrived daily before the contractors could start and usually left after the contractors finished at night.

Third, BNSF provided the materials for the contractors who did not have control or direct access to the material supplies. This situation required a great amount of communication between BNSF engineering, purchasing and materials, and the contractors to ensure the materials were provided precisely when and where they were needed. One full-time position was required to maintain this coordination.

Safety was given a high priority. All contract crews were briefed by BNSF on personnel protective equipment standards. Frequent audits were conducted to ensure compliance.

Unlike the original construction in the 1880s, fatalities and major injuries were not a part of the reconstruction. BNSF crews only sustained one FRA non-reportable first aid injury. The contract crews reported one lost workday case.

One December 7, 1996, a grain train was the first to make a revenue trip across the new Burlington Northern Santa Fe line. The route has seen as many as ten trains a day with an average of three to four trains daily. With the completion of the Stampede Pass line, BNSF now has three routes between eastern Washington State and the Pacific Coast. The Stampede Pass route is expected to save four to six hours per trip compared to the Southern Pasco/Vancouver route. With grain traffic diverted over the Stampede Pass route, the Cascade tunnel route can be used for high priority intermodal capacity.

As it turned out, Stampede Pass also proved to be a critical alternative route during the unusually severe weather this past winter in the Pacific Northwest. At times when existing routes suffered numerous mud slides and other blockages, the newly completed Stampede Pass line was the only route open through the Cascade Mountains. This led BNSF chairman Rob Krebs to remark that the Stampede Pass saved our life in the Pacific Northwest.

Legend has it that workers of the late 1800s stamped away from the Pass. Today, however, we are seeing another stampede – the rush of traffic crossing the Pass on this crucial third route in Burlington Northern Santa Fe's Pacific Northwest territory.

Please join me in viewing a five-minute video and then we will entertain questions from the audience.

(Whereupon there was a video presentation as follows:).

The story of Stampede Pass began back in 1881. Originally named Garfield Pass by an assistant engineer working for the Northern Pacific Railway in honor of the 20th U.S. president, the name "Stampede" came from a sudden head long rush of trail builders. Due to various extreme conditions on the Pass, some of the hired trail builders revolted and departed rather quickly never to return. The stampede of trail builders past the surveyors and other workers prompted the Pass name of "Stampede," a namesake that has stuck with this harsh bitter connection between eastern and western Washington for over a century.

In 1970, the Northern Pacific Railway merged with other railroads to form Burlington Northern Railroad. The Stampede Pass line was used for passenger and freight service until it was taken out of service in 1983 when the industry was sizing itself to become more efficient. Also in 1983, the eastern half of the line from Cle Elum to Kennewick was sold and became the Washington Central Railroad Company. Although the western half of the Stampede Pass line was never officially abandoned, only a 14-mile segment from Auburn to Ravensdale had regular traffic.

In October 1995, Burlington Northern merged with the Atchison, Topeka, and Santa Fe Railway to become the Burlington Northern Santa Fe Railway Company. In April of 1996, the BNSF Railway announced plans to acquire the Washington Central Railroad Corporation and re-open Stampede Pass reconnecting a third route into the Pacific Northwest and increasing their freight capacity potential.

What does it take to rebuild a railroad of this magnitude? A line that had seen limited use for 15 years? In June of 1996, after nearly a year of planning, the construction began. The Burlington Northern Santa Fe Railway employed a 200-man workforce teamed with 15 contractors and consultants. It took over 800,000 manhours in blazing hot sun and winter blizzards. With the arrival of winter and the deadline approaching quickly, increasing manpower and accelerating material deliveries were key, but the job didn't go like clock work. There were several challenges and delays along the way. Before track could be upgraded, many areas washed out by the floods required BNSF Railway to install new riprap and reconstruct roadbeds. Construction of the snow sheds on both ends of the Stampede tunnel was a major challenge for the BNSF Railway Company and Atkinson Construction. Landslides, rock slides and snowfall hindered progress. More than 300 inches of snow falls on an average each year on Stampede Pass with 100 inches by the end of December. This year, however, the snow fall was nearly triple the normal average through December 1996 totaling about 300 inches. This continuously falls next to the east portal of the tunnel from a nearby waterfall creating heavy ice build up, a constant threat to the track during winter. Canyon walls and excessive snowfall are a perfect recipe for an avalanche. That's why snow sheds are key to protecting the track. But building snow sheds was not a easy task. Work began in June and the snow sheds were substantially completed by December 1, 1996. The job required heavy construction at sites with limited access working 24 hours a day for over two months.

Another major work effort was the Stampede tunnel itself. It needed the complete wiring of electrical services for lights and three separate cables for radio and telephone communication. The track and ties inside this 9,834-foot long tunnel and through the snow sheds were completely replaced as work continued around the clock. This was done simultaneously with the final stages of snow shed construction at the east portal. First, the old track was removed from the tunnel in panels and moved by rail to Stampede siding where they were trucked to and then stacked at Lester for dismantling. After the tunnel floor was regraded, the new track and ties were installed with a modified track-laying machine. Communication along the line included the construction of five radio towers, an installation of a communication cable, and a radiating cable antenna in the Stampede tunnel to establish the dispatcher and data communication.

After six months of 12 to 24-hour workdays with no reportable injuries within the BNSF engineering work groups, the final track inspection was completed. All the challenges of this multi-million dollar construction project had been met and the Stampede Pass reopened.

Here's the first train making the journey once again over the Stampede Pass, through Easton and beyond onto the pages of BNSF's history journals in a new century of railroading.

Mr. Hesterman: Are there any questions from the audience that either Randy or I could answer at this time? If not, in closing I would like to take a moment and thank all of the contractors and vendors who helped make this project possible. It was quite a challenge to say the least and it would not have happened without a lot of teamwork and cooperation of everyone involved. Thank you. (Applause).

Mr. Sensing: Dave and Randy, we spare no expense in showing our appreciation. We have two certificates and two hats for you. We appreciate a job well done.

I would now like to introduce Dave Crader. I have known Dave for several years. He is a presenter of the Illinois Central/Canadian National intermodal facility. Dave began his railroad career with Peoria and Pekin Union Railroad in 1975 as a track laborer. He worked part time in the engineering department until graduation from Bradley University with a Bachelor of Science degree in civil engineering in 1978.

In 1980, Dave resumed his railroad career with P&PU working on a four-hour yard project rehabilitating the yard at East Peoria, Illinois. In 1981, he joined the Illinois Central as a roadway designer in Paducah, Kentucky. From 1984 to 1986, he served as project engineer of the rail barge unloading facility at Jessup, Kentucky. Dave served as division field engineer from 1986 to 1997 which included design construction of the Moyers Intermodal Facility in 1992, the bulk transfer facility in 1994, the CN gateway expansion of the Moyers Intermodal Facility in 1996, and the MIT phase expansion in 1997. He was promoted to his present position in March of 1997.

Please join me in welcoming Dave Crader. (Applause).

IC/CN's INTERMODAL FACILITY

Dave Crader

Office Engineer
Illinois Central

Thank you, Andy, for that introduction. I want to thank you for the chance to share my experience – the second chance in a lifetime to design and build an intermodal facility from scratch. The first, of course, was the MIT facility in 1992.

Our CN partners referred to the yard as the Chicago Gateway Facility. IC formally refers to it as the Moyers Intermodal Terminal, the Canadian National expansion, but we call it MITC for short. Despite the use of the cliche, MITC really has been a capital T, bolded and underlined, Team effort. There were literally hundreds of people and dozens of companies who worked long and hard on the project. I would like to take the time to recognize the special efforts of just a few. From the Illinois Central, Dan Kelley and Swede Johnson. Swede Johnson has been working for the Illinois Central longer than I have been alive, but he and I made a pretty good survey team. Chuck Godbold, Tim Kelly, Ray Banicki, John Smith, and Joe Viscum. Joe Viscum made this presentation possible, but I'll let you be the judge on how well I learned what he taught me.

On the Canadian National, Chris Taylor, Paul Rasmasson, who is now operating the facility, and Steve Serio.

Some of our consultants include Robinson Engineering, Ed Tunelias and Mark Weslauski performed the yard design, and construction inspector Dan Mach was so good we hired him for ourselves. Peter Kostur with K&S was responsible for the soil borings, the pavement section design and materials testing. Kuhl Rasdan designed the CN office building and the entrance and exit facility. Hugh Northern designed the A-yard office building. Dave Stromberg with CTE designed the crane maintenance pad. VZM Tram Systems performed CN's review and gave us lots of help incorporating the future expansion into the plans.

Some of our suppliers include Progress Rail, Lewis Rail, a Division of Holland, Railway Technology, and Koppers.

Major contractors include K-Five Construction Corporation. This was our project general contractor. Bill DeLisle was the engineering superintendent.

Airy's Inc. project superintendent was Tom Land.

There was also Keith Volkman with R.J. Harms, Mike Bergin with Castle Construction, Rich Lazuka with RJB, Joe Batagglia with Raffin Construction, and George Mendez with G&T Enterprises.

Breakout 5B Hump Scale Fdns.

N-End Yard SW. Lead

This is what was. The top left photograph shows the southbound hump looking down into the bowl. The top right photograph shows the forest between E-yard and MIT with a crossroad between the two facilities. The bottom left photograph shows the north end of D-yard and also shows the pole line that was removed and buried. The bottom right photograph shows the north end of F-yard which is now used for storage of empty intermodal cars for the MITC project.

A little background on the original MIT project will be very helpful in explaining the hows and whys of the MITC. This photo shows the northern two-thirds of the yard, the Interstate 80-94 bridge, the main lines running up the left side and, of course, MIT.

Markham Yard was ICRR's main Chicago class yard with both the northbound and southbound hump named rather originally A-yard, B-yard, and C-yard for northbound movements and then D-yard, E-yard, and F-yard for southbound movements. In 1992, the northbound hump bowl 64 tracks and nine tracks in the C-yard outbound yard were removed and the MITC facility was built. We sold our old IMX yard in Chicago to the SP. Track 16 in A-yard was used for the inbound/outbound lead and the rest of the yard was used for storage of empty intermodal cars.

MIT was built in three months in 1992 opening on Thanksgiving Day. It beat our project schedule by a month which had been Christmas Day, so we are really no strangers to tight deadlines. The land in C-yard was used for storing empty trailers and chassis.

This photo shows the MIT facility in use. The Gantry crane in the foreground is undergoing a bit of maintenance.

Since MIT was constructed, we have marketed excess capacity at our facility on other railroads. IC now handles both UPSP and Wisconsin Central trains at MIT.

In 1994, we expanded MIT and the upper left photograph shows the bulk transfer facility. We built two tracks, 52-car storage for direct transfer of plastic pellets from rail car to trucks. The truck scale and office trailer can be seen in the background.

The bottom right photo shows our expanded MIT facility. The original inbound facility had two lanes in and two out. The expanded facility has seven lanes, three in, three out, and a bobtail wing. Both of these facilities were also designed by Robinson and built by K-Five.

This brings us to the portion of the presentation concerning last year's project. The top left photograph shows the 75-foot Gantry crane purchased for this project at the south end of MIT. There is one unload lane, two tracks, and two unload lanes left to right under the crane. This crane has a cab on both sides so it never has to be turned around. It's equipped with auto-steer equipment so that the operator doesn't have to worry about keeping the crane on the pads. He only has to worry about unloading the train.

The bottom left photograph shows one of the side packers that was purchased working on track two. Two 50-ton reach stackers were also purchased.

The right photo shows a partially unloaded train on track number two as well as the container storage area on the right where future tracks three and four will be constructed.

C-yard construction started on February 28, 1996, and was completed in April. A-yard construction started March 3rd, and was open for service on August 13th. The entrance construction began in June, and the yard construction began in July. The first train ran into the facility on November 29th. The West Street portion up to the new entrance was reconstructed in March to May of this year and we are just now finishing up all the little details such as seating and putting the riprap on the flared-in sections, et cetera. The original estimate was $20 million which included the four pieces of equipment. The final estimate despite two complete redesigns is going to be $20.1 million.

This photo shows the MITC overlay. Two tracks are shown in dark blue, the container storage area is shown as the white strip to the right, the trailer work parking area with the dolly pads in orange, and, of course, the infamous duck pond wetlands and the untouchable drainage ditches are shown in light blue.

W. Embankment – Sheet Pile Wall

Looking South – Aerial View

We began talking with the CN in late summer of 1995 about 100 percent container yards for storage under a 75-foot Gantry pad to minimize the handling of the containers, but the talks died down during that fall. On January 16, 1996, vice president of maintenance Dave Kelly called me and asked about my vacation plans and told me to cancel them. We immediately resumed design meetings with the CN and on February 20th, the contract with CN was signed. This contract called for construction of the trailer container facility estimated at $20 million and an opening date of December 1, 1996, was set.

The embankment area was squeezed between the duck pond wetlands on the left and the rip track facilities on the right. This caused us to wiggle to the right and then back to the left. Over 50-acre feet of detention can be impounded on the two wetlands so we get return on otherwise wasted area.

The new yard contains about 1,100 trailer spots and 2,200 container storage spots and has room for 22 five-pack units on each track. New construction often requires demolition of old structures and it's amazing how much concrete the railroad has poured in the last 70 years. It took Airy's two weeks to break up and load all of the old foundations, building slabs, and abandoned footers not including the hump scale shown in the upper left photograph.

This photograph shows where we cut the hump down 19 feet. We found three scales stacked on top of each other. We knew about the first one; however, we didn't know about the other two. We didn't take out all of the concrete. I don't know if you can see it or not, but there's a paint mark that shows where we took the concrete down to. The right photograph shows the demolition of the old pumping station from the old steam locomotive days. The bottom left photograph shows the hump area where almost all of the concrete has been removed down to grade. Despite all the old timers' claims we never did find the buried steam locomotive that was there. (Laughter).

These photographs show some of the work that was done in C-yard. Three new tracks were constructed. Track 10 was rehabilitated so that A-yard could be used for classification. Unload track C-7 when combined with MIT No. 1 permits storage of a 5,600 foot train and the combination is used to handle the Wisconsin Central. Both C-yard and A-yard tracks were constructed using six by eight ties, 110-pound welded rail, double shoulder plates, cut spikes, and spring anchors.

As you know, Mother Nature can be unkind. The night after we first laid out ties, it snowed six inches, but the snow was plowed out and tie placement was resumed by 10:00 a.m. that morning.

Some of the details from A-yard, the four additional tracks hold 160 cars and brought the total tracks in the yard to 20 for inbound and outbound, 15 classification, and one light repair track. The yard lead angle was originally laid out for ten No. 7s, but the old yard used multiple No. 8s with sharp curves behind them. The new yard layout uses five groups of three No. 10 turnouts in a fan pattern with short five degree curves behind them. The two inside turnouts of each group were equipped with push button operated hydraulic switch machines. They were equipped with 100-volt AC power for recharging the batteries instead of the normal solar power units. The machines were designed to throw the switch up to 700 times after power loss. We operated them for four weeks without recharging before the power hook up was completed.

The north end of A-yard goes under I-80-94 and over 171st Street within 300 feet. We raised the switching lead about two and a half feet to a minimum 21-foot overhead clearance to the interstate bridge in order to provide rolling car speeds of four to six miles per hour down the lead. We used 36 No. 10 panel switches in rebuilding A-yard. We replaced No. 12s with No. 15s and constructed 6,500 feet new intermodal lead to allow 20 mile per hour operation into and out of MIT. We constructed a new yard office.

The top left photograph shows tracks 18 and 19 under construction. The wide spacing between tracks 17 and 20 was the result of IC's banana trains. The track on the left, No. 20, was called the banana track for good reason. Merchants drove trucks and people walked or

N. End A. Yard

Striping at New Parking Lot S. of CN Building, Facing North.

drove cars through the area where 18 and 19 were built and bought bananas right out of the railroad cars.

The bottom photograph shows the panel turnout and the new switching lead and the overhead interstate bridge. The new MIT lead under construction is shown on the right and the north inbound/outbound lead shown on the left.

The top photograph shows some of the finished turnouts with the hydraulic switch stands. The push button posts on the side were spaced 10 feet apart to prevent pushing more than one at a time. They've worked so well that we planned to put the hydraulic switch machines on the five lead turnouts this year. The MIT lead, again, is shown on the right. We took the blue building shown in the photograph and moved it a mile and a half to the north and put an air compressor in it for the yard air for MITC. It's also the area where the A-yard office was built after this photograph was taken.

The bottom right photograph is an aerial shot of the yard taken in October. The new MIT lead construction is the little white line right down the middle of the print. This shows the A-yard office and, of course, the little blue building that we moved is right there also.

For the yard construction, we built two tracks of 7,200 foot clear. It is designed to handle about 60 percent containers and 40 percent trailers. It's laid out for two future tracks. We used the maximum three-tenths percent grade, five degree curves, and No. 10 turnouts. The concrete Gantry pads were 6 foot by 16-inch reinforced concrete and the auto-steer cables were cut in after construction. All of the trailer parking areas have five foot by eight inch thick concrete dolly pads.

The top left photograph shows some of the rebars. It also shows one of the 20-foot thickened sections where we added 12 inches in depth and additional layers of rebars over the drain or water pipes. This is our response to problems we encountered at MIT in 1993 which involved difficulty in compacting the sand fill around the pipes. It also shows the typical end section of the pad with the second layer of steel on top.

The next photograph shows part of the parking lot has been graded and compacted as well as the top of one of the heavy duty catch basins. This is the ready yard located just south of the entrance where the containers or trailers for each day's trains are dropped off by truckers. It's very short-term parking usually less than eight hours with room for about 75 trailers.

This MITC aerial photo was taken in October and shows about 130,000 tons of stone on the ground. The C-yard building is shown as well as the ready yard. The Gantry pads are shown, too. Of course, in the ready yard we had the trailer dolly pads. The north yard lead is shown and shows the crash walls that we built on the drainage ditch bridge and the infamous duck pond as well. West Street reconstruction into the entrance is shown. The ramp up to the facility is across from that. The 159th Street U.S. Route 6 is underneath.

The typical yard design had a typical 16-inch deep pavement section as well as some of the restrictions. We put the heavy duty precast structures wherever there was a chance a side loader could run over them. We standardized two sizes, 42 inch or 60-inch square depending upon the size of the pipe with 8-inch thick walls and 10-inch thick flat tops. Each structure base has the same depth which required a different sump beneath the pipes instead of the constant sump and different depth on normal round drainage structures. We placed precast barrel sections on top of the base for the deeper structures.

This photo on the left shows the installation of a portion of the 850-foot sheet pile wall on the west side of the yard along the duck pond.

The next photograph shows filling the drainage ditch on a 60-inch pipe directly opposite the sheet pile wall.

This photograph shows part of the finished east embankment with the erosion protection search flag in place. Some of the miscellaneous work done at MIT will be shown on the following slides.

This photograph shows one of the 12 power distribution switch gears installed. Each of the cable termination kits shown required about 60 minutes to complete. About four and a half

miles of very buried power distribution work and installation of 12 switch gears and seven transformers was completed by three IC electricians.

This photo shows one of our "oops!" The operator didn't know he was cutting through the pipe and other large chunks of concrete and slag encountered in this whole fill area during the trenching. The cables and protection tape are shown in the middle of the photograph.

This photograph shows contractors setting the top portion of 145-foot pole replacing a 95-foot glass tower on the 34 KV distribution line. The adjacent 138 KV transmission line had already been raised to provide clearance above the Gantry crane.

This photo shows the cross connection of the Gantry pad between the two facilities.

This photograph shows the rebars of the crash wall we put on either end of the Cal Union drainage ditch bridge.

This photograph shows Mother Nature at work again. Nine days before the first train was due, it snowed eight inches. Cold weather and this snow delayed asphalt work and resulted in 48 hours continuous paving by two crews to get it done in time for the first train into the yard.

The entrance includes four lanes that can be expanded to seven. Three outbound lanes were constructed, but due to staffing levels, are not presently being used. The CN office building went from a 30 by 40-foot gate facility to almost division office size in order to accommodate all the CN people who wanted to be there. CN installed a state-of-the-art camera inspection system so their clerks need not leave the booths. Monitors show the trailers from various directions including the top.

We reconstructed West Street from 157th Street one and a half blocks south to the new entrance, a half block north of 159th Street or U.S. Route 6. We tried to install a signal at the 159th Street intersection but IDOT said there was too much congestion to slow things down with a signal. Probably 75 percent of the trucks in and out still go to 159th Street so there probably wasn't too much congestion after all.

This photograph shows the CN entrance facility with the yard office on the left, the overhead canopy, the stop and go lights over the booth, and various cameras. There are seven cameras on each lane so they look at the truck at various directions. Some are also placed to see the top of the trailers.

The Mylars shown in this pipe are eight inch pipe set in a two-foot diameter four-foot deep concrete foundation and filled with concrete. I have seen trucks hit these and bounce off whereas the scrap rail bailers we install at MIT will have to be replaced because many of them have been pushed over.

This photo shows setting one of the check-in booths. This photo truly is one in 1,000. I took over 1,000 photographs myself, but in this case, I gave the camera to someone else and they got me in it.

The next photograph shows the new booths as well as the skirt that was installed underneath to raise the clerk up to the trucker's window level.

This photograph shows the south base of the CN office building, the employee parking lot, and the entrance and canopy to the left. It shows the inbound facility being used for outbound work as well. The outbound lanes are to the right of this jersey barrier wall.

This photograph shows the interior of the office with the modular furniture.

These two photographs show work on West Street. We rebuilt West Street from 157th Street at the top of the photograph to the new yard entrance at the bottom left.

The MIT crane maintenance pad was our response to the EPA citation for water pollution. We installed a 60-foot by 110-foot concrete pad work area. It's used for washing the various vehicles and trains, catching spills during routine maintenance or handling major malfunctions. A two-way manually operated valve with handle work similar to a high switch stand allows normal rain to run off to the storm sewer, but contaminated flows go to primary treatment, in this case grit removal and oil and water separation, prior to discharge into a sanitary sewer. This facility cost us about $270,000.

This photograph shows the various pollution control facilities at the crane maintenance pad, the grit chamber, the oil/water separator, a sampling manhole with the flow measurement flume inside.

This photograph shows rebars at the trench section on the Gantry pad. One of the hostler operators told me we really didn't need to fill any concrete in here; we just needed to fill it with stone and smooth it out.

A few minor details on the work completed by IC forces include our track people installing 11 miles of new track, 63 new and 5 secondhand panel turnouts lined over a mile and a half, relaying three additional track miles, and our signal department installing six power switch machines at the north end of the yard in order for CN to access the yard and the electricians installing the power distribution system and removing the two pole lines.

Some of the details on the contract work include 160 cubic yards of excavation was placed and put back in as fill. No additional fill was brought in off the site. A total of 40,000 tons of asphalt and almost 40 acres of paving was used on West Street at the entrance of the yard and the crossroad. A full 288,000 tons of stone was used for the road base and then parking areas. That's approximately 14,400 tickets which stacked up make a stack three and a half feet high and it's on the desk in the construction trailer. We also have 2.9 miles of concrete Gantry pad, a half mile of asphalt Gantry pad, 1.9 miles of trailer dolly pads, 2.6 miles of drain pipe ranging from 12 to 60 inch, 40 heavy duty manhole structures cost about $5,000 a piece, 39 regular manholes, 3.5 miles of water line, 36 fire hydrants for fire protection, and 19 light towers each 100 or 120 feet tall with 10,000 watts of lighting each which is 190 kw of watt lighting, 1.5 miles of air line including a 75-horsepower compressor, storage tanks and an air drier system.

What now? The IC is presently completing a phase four expansion. This right photograph shows some drainage work in C-yard area including one of the heavy duty precast structures. The new track C-6 which will store 5,400 foot trains will be built in this area. The working yard between track C-6 and C-7 will provide additional parking as well.

This photograph shows part of the 7.5 acres of additional parking that we built and the 1.5 acre detention pond that we built is just off the lower left corner.

What's next? In 1998, we will complete a 12-acre trailer repair facility adjacent to MIT. What about 1999 or beyond? During the inauguration of the facility on May 16th, CN's president Paul Tellier gave a challenge to his people to expand their traffic enough to force the phase two expansion prior to the year 2000. This will require 220,000 lifts per year versus the 150,000 lifts total estimated for 1997 at MITC.

The photograph shows the CN locomotive breaking through the banner at the inauguration.

This photo shows a footprint of the phase two expansion with two additional tracks in dark blue and additional trailer parking. The area around the UPS facility is the 12 acres we just purchased and will be using for the trailer repair facilities.

I would like to take this time to give thanks to Dave Kelly and the Roadmasters and B&B for this opportunity. Thank you for your attention. (Applause) .

Mr. Sensing: Thank you, Dave, for an excellent report.

I have just a reminder for anyone who wants to vote in the election and has not already sent in a proxy. Please see the gentleman from Corporate Election Services out in the front. You must pick up your ballot by 11:45 a.m, but you do not have to turn it in until after the discussion period at 12:00 noon. All the ballots must be in by 12:30. Thank you.

At this time, we are going to take a short recess. We will reconvene back here 9:45 a.m. I apologize for the audio/visual displays. Our technicians are working on that. If anyone has a power point presentation as part of this we need to make sure it is 100 percent compatible before you go up there. Thank you. (Recess).

Mr. Lileikis: You are going to hear this announcement throughout the course of the morning, but if you have not previously submitted your proxy for the merger vote to be held here at 12:00 noon today and you wish to vote, please see the gentleman from Corporate Election Services. You need to get the ballot from him before 11:45 a.m. You have up until 12:30 to vote if you have not yet done so.

On the program you will note that we have at this time a keynote address. Unfortunately, approximately a month ago I received some bad news from President Clinton who had planned to come and do the keynote address. About a month ago he indicated he could not make it due to another commitment. I see there's a lot of happy people here over that cancellation. I heard a little applause so that must be the Republican delegates. (Laughter).

With that, Joe Riley has graciously volunteered to give us a presentation on a system approach to right-of-way safety.

Besides being a member on the Roadmasters board, Joe is engineer of standards and quality assurance with Metra. He is a registered professional engineer in the State of Illinois. He started his railroad career in 1974 with the Chicago & North Western as an assistant roadmaster. Then about a year later he figured he found out everything he needed to know about track so he came over to the B&B side in 1975.

In 1978, he joined RTA Metra as a project roadmaster and was promoted to director of engineering of the Milwaukee district in 1982. In 1983, he was promoted to assistant department head engineering and maintenance and in 1987, he was promoted to his current position.

With that, please welcome Joe Riley. (Applause).

A SYSTEM APPROACH TO RIGHT-OF-WAY SAFETY

Joe Riley

Engineer Standard Quality Control
METRA

Thank you. As you can see I am not Bill Clinton. If you came here basically to hear a message about the economy, about the only thing I can tell you is that revenues are up but we didn't get much of a raise last year. (Laughter).

But I do have a message for you here today. I would like to talk about a familiar topic – safety awareness – but maybe from a slightly different angle than what you have been exposed to in the past. Certainly injury reduction ranks among one of the most major topics that we as maintenance-of-way officers face today. We have responded admirably to the challenge. Whereas the frequency ratio of 5.29 injuries per 200,000 man hours worked won Metra the gold Harriman Award several years ago, it wouldn't even secure a fifth place in the class B category today. From all appearances, Norfolk Southern is on its way to a record seventh consecutive Harriman gold with a frequency ratio of .8 the last time I looked. BNSF is closely behind also with a ratio of less than one. That's pretty impressive considering that predecessor road Burlington Northern had an average of slightly greater than 16 several years ago.

However, no one approach is adequate for reaching the goal that we all want – no injuries. It takes top down management involvement as described by Norfolk Southern's Phil Ogden at

AREA last spring. It takes front line supervisors making safety a priority and bringing labor into the picture. Certainly industry cooperative efforts with the FRA is important. Workforce safety initiatives and functions are, too. As an industry, we have spent millions on upgraded task and procedures training. Just look around you at the exhibits here as well as out at Kansas City yard. If it's not directly related to safety, it certainly has safety functions designed into it. Obviously maintaining constant presence of mind is very important, too. The rule book has always stressed and we stress to our people to continually remind them that safety is the most important element in the discharge of duty. But it seems as though we leave it up to them to figure out how to do that.

Recognition that a situation is hazardous or has potential for harm is not always intuitive. We need a strategy for doing this and we need a means of effectively communicating that strategy to our people. This is a segment of the process that I am not sure we have all adequately explored. Perhaps the approach we have initiated at Metra is one way to deal with this particular problem.

Now each of us knows that the railroad environment is a potentially dangerous place to work which requires a constant level of alertness in order to keep out of harm's way and our employees know it, too. But do they really understand why? It's more than trains being very unforgiving. It's that familiarity breeds content. When was the last time you remember a new man getting hurt? Unlike McDonalds or a factory job or the office where one has control over the environment, where one is doing exactly the same job he did yesterday with the same people in the same location, the environment that our employees are exposed to is continually changing. It demands constant awareness or constant presence of mind. The employee better remember that if he is going to stay out of harm's way.

But can we really expect anyone to maintain constant presence of mind in this day and age? Our fathers could. But, then again, they lived in a world where a man had a job for life if he wanted it. Supper was on the table when he came home from work. The wife took care of the kids. He didn't have to deal with all of the social ills that affect society today with single parenthood, elder care and making sure the kids get picked up after school. The fact is there are just too many competing interests in life today for most people to be able to totally and completely shut off their private life when they hit the door of the headquarters. Yet with all of this that we face, did you ever wonder why some fellows can work 30 and 40 years without suffering an injury and yet others seem to suffer an injury year in and year out although often they are minor. Are those repeaters lousy workers? Are they lazy? Are they irresponsible? Are they less intelligent? Don't they give a damn? Sure, in a few cases that fits the bill. But in most case, that isn't so. In fact, for us in many cases they are among our best and most productive workers. At Metra a lot of times they are the foremen. Why then do we have the seemingly diverse dichotomy between these two groups of people? Luck plays a part. Fate and probability dictate that a certain number of people are going to be at the wrong place at the wrong time. Yet fate still doesn't seem to affect that rather large segment of our workforce that never or rarely ever suffers an injury. What then is the difference?

I believe that the safer group of employees has developed a system to heighten their level of awareness, in other words, their constant presence of mind when they really need it. It appears it is a subconscious thing they developed on their own experiences. What is the system that they have actually developed? I have yet to find anybody who can verbalize it. When you ask the fellows who never get hurt what they do and what is different from what everybody else does, they just say they are careful. Again, it's inherent and subconscious. But then the repeater is going to say that he is careful, too. And you know what? In most cases I believe him. The difference is in how he is careful. What I believe is that a rather large segment of our employees can categorize the signs of a potential problems into a couple of broad categories. They look for the broad categories rather than the specific individual hazards. It's the recognition of one of these categories that automatically triggers the brain to cause the body to slow down to take a good step back and to take a good look around. In other words, to raise one's

level of awareness through constant presence of mind a couple of notches.

Now, you know, most of us like to hear the sound of our own voice and can talk pretty fast if we have to. But in 1,000 years, we could never describe or come up with all the ways or possibilities of getting hurt out there. There are just too many variables. There are too many possible combinations of seemingly harmless circumstances to be able to recognize each circumstance for its potential for harm.

Take a look at this picture. This is Joliet, Illinois, near the end of our Rock Island District. Who in here would recognize that signal bridge or the location of that welding truck or that pickup as being by themselves a significant hazard. Yet two very good, safe and experienced trackmen died here. Some would argue that the cumulative effect of that bridge and vehicle placement contributed to the accident. But what really killed those two men is that they forgot to expect a train on any track in any direction at any time and to never step into the foul without looking both ways. For the one critical second when they really needed constant presence of mind, they didn't have it. Believe me, they were both very good and safe employees.

The view of the approaching train as shown in this picture was clearly visible all the way out to 11 feet from center line of track. Only at this point did their view become obstructed and then the combination of the location of that bridge, trucks, and tools probably did play a part in the accident at that point. We need, then, some means of recognizing these broad based categories when they appear or a plan, if you will. Because if you wander out there without a plan, the basic laws of probability say that very shortly or at some point down the road you are going to run into trouble. If you are out there looking for all the individual ways to keep from getting hurt, you haven't got plan. Sooner or later you are going to drop your guard and something is going to reach up and bite you. Why? Because, again, no one can maintain constant presence of mind 100 percent of the time and no one can recognize every situation for its own merit as being potentially harmful.

However, the situation isn't as hopeless as it seems. Each of the myriad of potentially harmful combinations of circumstances has one or more of a couple of common identifying trademarks. The plan, then, is to look for the couple of identifying trademarks rather than assessing each situation.

My goal today, ladies and gentlemen, is simple. I would like each of you to walk out of here with a system. The idea is to work smarter, not harder. This simple system helps to identify and avoid factors which can lead to injury. The other half of our plan, of course, is to implement strategies or actions to neutralize those factors when they are recognized. Taking appropriate actions can literally mean the difference between life and death. That part of the equation most of us in the industry, I think, have done a pretty good job of through training. It's the recognition part where our people seem to fall down on us.

Before I get into the details of that system, take a look at this situation. It's something I think we have probably all experienced. Your gang has been out there digging in ties to fix a couple of bad nests that extend over a railing.

Four or five ties down somebody set a jack and Foreman Jones is working away from that jack slipping in the tie plate. He's smart. He slides the plate in from the crib being careful to hold the plate by the edge and never permitting his hands or fingers to get between the base of the rail and the ties. From his blind side, up walks a trackman who needs the jack for his nest of ties. As Jones slips in the last plate, Smith drops the jack without looking and then and only then shouts "jack down." Well, all of us has experienced this at least once probably. You probably can't have worked in the track department and not have somebody drop a jack on you. Oh, by the way, I know none of us have ever dropped a jack on anybody, have we? But let's talk about this situation for a second. It will help us to basically understand some of the concepts that we are going to discuss.

First of all, we all recognize that a warning should have been given to drop the jack, and that Smith should have ensured that everybody was in the clear before doing so. Smith,

although Jones probably had a different name for him at the time, knows if you were to question him that he should have done it the right way, too. So what went wrong here? Why did Smith do what he did since the situation could have cost Jones a couple of fingers. Maybe Smith is just inconsiderate. Maybe he assumed that Jones would get out of the way. Maybe he had his mind elsewhere. Maybe he is just plain careless and has bad work habits. There is a whole raft of possible reasons as to why.

Now let's take this thing and replay it again and add a couple of complications. Temperature is about 34 degrees out and it's starting to sleet and snow. The evening rush is quickly approaching. The gang has about 20 minutes to get everything spiked up, anchored, and cribs dressed off. It's just about twilight and Jones is wearing dark clothing. Smith is a relatively new employee and he is not probably dressed for the weather. He just got bumped out of his gang near home and that forced him into Jones' gang nearly 50 miles away. By the way, Jones has been on Smith all afternoon long about getting off his tail and that this isn't the other subdivision which is inhabited by less-than-industrious fellows. Smith is tired and so is the rest of the gang. The rest of the gang is spiking the rest of the rail near Jones. That's probably enough. By now, I think you are probably starting to get the idea. The point is that factors in our environment which frequently change like weather or light combine with our personal actions to make the situation more or less dangerous.

I am going to come back to this example in a couple of minutes, but I am now ready to give you the terminology for describing our systems approach. The following three categories could be used in improving one's level of awareness in identifying a hazardous situation in determining the proper resection or response. The categories are:

1. Personal Factors
2. Environmental Factors
3. Movement

Personal factors include all those things which affect the way you perceive your environment or your actions or response to that environment. These factors include your vision, your hearing, your thinking, your preoccupation, and your alertness. It includes your actions and response to those factors. To put it in another way, personal factors include the things that you, that are a part of you, or that you, yourself, can actually control.

Environmental factors, on the other hand, include all those factors that are outside of you. For example, the weather like snow, rain, ice, sleet, lightness and darkness, and noise. How about that open manhole that you never got around to replacing the cover? Sure, that's another example there. A simple way of looking at this category is that it's all the factors outside of you or outside of your control which you have to be aware of so that you can adjust your own actions accordingly.

Then we come to movement. That's our third category and let me explain it. This is the category that is especially akin to the railroad industry. Obviously, we always have to emphasize the need to be constantly aware of moving equipment from any direction, on any track, at any time. Movement demands awareness. We are not just talking about train movement. It doesn't make much difference whether you get run over by a train, backed over by the end loader, or hit in the head by a spike maul. Dead is dead. Movement may be difficult to detect. One has to train oneself to constantly look for it. It really is necessary to develop that practice of looking over your shoulder and ahead every 15 or 20 seconds whenever you are out there on the main line, in the yard, working on dead track or even on a siding that hasn't seen a car in 30 years.

Unfortunately, a lot of fellows never develop that practice or perform it religiously. Failure to expect a train or a movement of any kind on any track from any direction at any time is the leading cause of fatalities in our industry. But before we explore applying these three factors to our every day job assignment, let's go back to that track jack example. I think you will see how these three categories, personal factors, environmental factors, and movement,

can help you recognize hazardous situations and anticipate appropriate action.

Let's go back to it. The gang has been digging in ties to fix a couple of bad nests – environmental. There's poor footing in the cribs. They extend over a rail length or two. The temperature is about 34 degrees and it's beginning to sleet and snow – environmental again. The evening rush hour is quickly approaching and the gang has about 20 minutes to get everything spiked up, anchored, and cribs dressed off – personal as you are under stress. It's just about twilight. Jones is wearing dark clothing – environmental. Four or five ties down somebody set a jack and Jones is working away from the jack movement slipping in the tie plate. He is smart. He sticks the plate in from the crib – movement – being careful to hold the plate by the edge – personal – because he is thinking never to permit his hand or fingers to get between the base of the rail and the tie – environmental. Up walks John Smith from his blind side and he needs the jack from his nest of ties. Smith is a relatively new employee – personal – and he is not dressed for the weather – personal and environmental. He just got bumped out of his gang near his home and was forced into Jones' gang 50 miles away – personal. By the way, Jones has been on Smith all afternoon – personal – about getting off his tail and that this isn't the subdivision which is inhabited by less-than-industrious fellows. Smith is tired and so is the rest of the gang – personal – fatigue. The rest of the gang is spiking the other rail – movement and environmental – noise. As he slides the last plate in, Smith drops the jack without looking – movement. Then he shouts out, "jack down" – personal.

Our example is what we call a situation although a very hazardous one. As you can see, all three categories of injury factors were evident in our example in many different ways. If you think about it, that's the way it is practically in every situation we encounter out on the job. The simple recognition of even one of those factors being present should be the signal to step up that level of awareness. In other words, jack up your constant presence of mind.

It's important to understand that the three categories of factors combined to make a situation more or less hazardous. Go back to our example with Joliet. The basic idea is to adjust one's actions and personal factors as much as possible to eliminate or reduce the probability that any combination of these factors may result in an accident, an injury, or God help us, even a fatality.

Let's talk about a personal factor with which we have all had some experience; that is, being preoccupied. Let me ask you, is there anyone in here today that is preoccupied? I didn't think so. In our environment, being preoccupied is a disaster waiting to happen when you combine it with the many environmental and movement factors in each situation. But preoccupation can be broken down into two elements: the first type of preoccupation is strictly a momentary distraction that with the exercise of self discipline can immediately bring ourselves back into focus. Then there is the other type of preoccupation that is more insidious. It concerns the type of problems that continue to gnaw at us. They are the ones that we can't put out of our minds. You know, we don't want people out there with problems and concerns which occupy their attention. However, situations may arise like serious personal problems which are out of one's control. Right away, you are probably saying, oh boy, here comes the drug and alcohol stuff. But it's more than that. It's marital, emotional, financial, child, elder care, and sickness problems. They can all do the same thing.

You know, some fellows believe that a man ought to be able to handle his own problems without outside help. But let me tell you, the real man is the guy who is smart enough to recognize when he can't deal with the problems and secure that needed help. As supervisors, we have to be aware of the signs that an employee is not dealing with a problem. That won't happen unless you are in tune with your people. It may have not been part of your job description 10 years ago, but it is today. Action of some form, whether it's a heart-to-heart talk or referral to an EAP program or whatever other resources are available to you, need to be initiated quickly, done with diplomacy, sensitivity and, of course, confidentiality. Most of us aren't comfortable with this particular role. It takes a measure of risk to do it. But to abdicate that responsibility may produce a risk of even more serious consequences.

The other key personal factor is fatigue. It happens to all of us from time to time. Fatigue also affects personal factors like judgment, motor skills, vision, and reaction time. For most of us, eight hours or better of hard physical work on the job is exhausting. The body needs adequate rest to replenish itself for the next day. Staying up to midnight to work on a home-improvement project or a second job just doesn't allow for adequate rest no matter who you are. As supervisors we have to stress to our people that they get enough rest before coming to work.

I would now like to put these two personal factors, fatigue and preoccupation, among the others in the context using two examples with which we, at Metra, are familiar. Although most of you didn't know him, Dave was probably one of the most safety-conscientious employees at Metra. As local chairman of BRS, he was also signal supervisor Hester Saylor's right-hand man. He never turned down a call. You could always count on him to find the problem and take care of it. For over 20 years, he provided loyal, safe service to the carrier.

The day of the accident, Sunday, November 24, 1989, dawned cold and brisk. Dave had been out all day digging in cables south of Riverdale, Illinois. As evening approached, he proceeded back to the crossovers on track No. 2 immediately south of Kensington on our railroad on the C&EI bridge. The track department had been out there undercutting under the bridge and they are now servicing track No. 2 and planning to complete the run off into and through the switch. There is a pedestal junction box out there and he actually moved it earlier so it would be out of the way of the tamper. It was obvious he was going to need relief in the hours of service as the tamper was still under the bridge. His 12 hours would be up shortly. After requesting relief, he returned to the crossover ostensibly to update his relief man on the work needed to be done.

This picture depicts the view Dave had to the north, the direction from which the train came. It's taken from the spot where he was struck and killed. There were a number of unusual environmental factors involved that night. The bridge pier, I don't know if you can see it, a platform curve, the home signals for the interlocking plant, and darkness distorted his view to the north. The approaching tamper on track No. 2 with its loud diesel and tamper spotlights shining down on the work heads and the rotating amber beams served to further complicate the situation. Shortly before the accident, there were two southbound trains sitting in that station; one to go over the branchline to the far track to the right down to Blue Island and the other one was the main line train, both in the station at Kensington. A protection order predecessor to the Form B that we now use had been put out to protect the track work that had expired at 3:30.

Both train engineers realized that the order had expired; however for whatever reason, personal factor, I guess, the Blue Island district engineer noted the track work still going on out there and he called for clearance anyway. The probable and obvious inference for Dave was the Blue Island train was coming first. Sunday evening was not a time that he was regularly out on the property and the schedule was probably unfamiliar to him. The Blue Island train, in his mind, was obviously utilizing the Blue Island lead two tracks away on track No. 2. Now the rule states that one should clear all tracks on the approach of a train. However, Dave was probably tired and cold. He may have glanced at that approaching train. The bridge pier and the platform curve may have provided the illusion that the approaching train was on the Blue Island lead. It wasn't. As the engineer left the station he was surprised to see the tamper out there on track No. 2. His attention as he approached the C&EI bridge was distracted by the amber rotating beacon. He was unaware of the man kneeling near the junction box who stood up and slowly backed up into the foul of track No. 1. The track crew was well aware of the approaching train. It had cleared track No. 1 and was standing behind the tamper at the bridge. Several men including the roadmasters saw Dave back into the foul of track No. 1. Their warning screams were drowned out by the noise of the tamper. Besides that, Dave was wearing a hooded Eskimo suit. Several men threw their flashlights or lanterns, but who can throw a lantern 120 feet? The engineer threw the train into emergency when he heard the thump. He was only doing 30 miles an hour.

Bonder Dave Foley was one of the first to get to the body. As he rolled Dave over to administer first aid, the remaining air purged from his lungs. For the rest of my life, I will never forget sitting in our director's suburban operations office the next day listening to the tape of the radio and phone conversations that occurred the previous evening. First Dave's voice as he called for relief. Then DC lead electrician Jim Keener's gut-wrenching call requesting an ambulance. I will never forget those unidentified radio cries, "Where is that ambulance! For God's sake, what is taking so long?" Or Keener's reply to Randolph's requestion for assessment of the injuries, "I don't think he's with us anymore."

We listened to the conversation as Randolph informed relief signal supervisor Ralph Spargo of what had transpired. You could feel Ralph's anguish as he repeated over and over, "Oh, God, no! Oh, God, no!"

Finally, let me tell you what it was like to walk through that signal headquarters in Kensington the next morning. The entire group was numb. No one could believe it. Men shed tears for what couldn't be. I went out there to offer condolences, but as I walked through that room, that was absurd. I said nothing. I got into my car and I drove away.

You know, we all take little notice of trespasser/passenger train incidents. Fatalities occur all the time and we are pretty blase about it, but when it's one of your own, it hurts. I don't know about you fellows, but I never want to go through this type of thing again.

In retrospect, we will never really know what happened that night and why, but two things were pretty clear. One, there were plenty examples of personal, environmental, and movement factors present that night. Yet if the recognition of just one of those factors had been noted that night by Dave, if he had just raised his level of awareness just one more notch, Dave would still be with us here today. And, secondly, to not clear all the tracks upon the approach of a train regardless of what track the train is occupying or regardless of what the track center is, is to invite trouble.

The other fatality occurred in May of 1990. Sally's accident was not considered an employee fatality because she technically was not on duty. But to her family, to her friends and co-workers, that's a technicality that means nothing.

Sally regularly was a conductor pilot for our Burro crane on our electric district. With over 10 years of service, she was considered one of the best pilot conductors on the district. She, too, was an extremely safety conscientious individual, famous for ensuring that everybody in the area was in the clear, not just the fellows working with the crane before she cleared a train. Having just returned six weeks earlier from maternity leave, she was full of life. With two kids, a husband who was a locomotive engineer on a different railroad, she was in her mid 30s and everybody loved her. She took the job seriously and she was a pleasure to work with.

On the morning of the accident she entered the roadmaster's office at Kensington obviously distressed. Her assignment that day was to work the Burro crane downtown at 12th Street. She was running late and she had missed the suburban train that normally took her downtown. Although the roadmaster assured her that Randolph wouldn't let the Burro out of the yard until after the rush and there was plenty of time to get downtown, she still left the office upset. We will never know what had upset her. Perhaps the baby was fussing. Maybe she was just upset about being late. But for whatever reason, she was preoccupied. She had a train to catch that was due in a few minutes.

Now, there are basically two ways to gain access to the platform at Kensington from the parking area. The proper method is to walk down the road, cross under the underpass at Kensington Avenue, and then back up Front Street to the stairs at the platform. This is a seven or eight minute procedure. The quick and improper way is to cut across the office track, a couple freight mains and commuter mains to get to the platform. Kensington is a beehive of activity on our railroad. The South Shore enters and leaves us at Kensington. Vision to the south is blocked by the tower and the C&EI bridge.

Sally chose the latter route to get to the platform. Unfortunately, a slow-moving

southbound train blocked her access to the platform and her view to the south. Time was growing short, but her train was expected shortly. Immediately after that last car had passed by, Sally darted out into the track. This woman who was always so very safety conscious of everybody else's safety let her own guard down and broke the two cardinal rules of railroading – expect a train from any direction on any track at any time and never step into the foul of any track without looking both ways.

Sally apparently never saw the oncoming northbound suburban zone train until it was too late. For a second, her eyes locked into the eyes of the train engineer, an acquaintance of hers. But there was nothing that could be done. Personal, environmental, and movement factors, ladies and gentlemen. They were all there and the big personal preoccupation. The recognition, again, of any of these factors by Sally would have probably prevented this accident. It's a bitter lesson for us to learn not only at Metra, but for the industry as a whole.

Now, let's spend a little bit of time on movement. Roadway Worker mandates that all employees be in a designated place of safety 15 seconds before the arrival of a train. It also stresses that one must take into account reduction of site distances or hearing. Judging accurately the speed of trains particularly at night or in poor visibility or in poor conditions is nearly impossible. Another provision of Roadway Worker is the engineer must sound bell and whistle any time he notices maintenance-of-way workers. It's the reason we are all out there in those orange vests. All of us know that we can't rely on the train engineer to watch out for us, but do we really believe it? After a while, trains become a nuisance to the man out there on the ground. For us, other than at rush hour, they come relatively infrequently. It's very easy to lose track of the time out there particularly when you are performing heavy physical labor. We have all been startled by the sudden blast of the horn or the bell when a train is still a fair distance away. There is comfort in that bell or whistle and it's only natural that we begin to rely on it for that warning. It's also natural to expect that the train engineer views the situation in the same manner that we do. In other words, his priority is also to make sure that he doesn't hit anyone.

Well, it's true that the engineer certainly doesn't want to hit anyone, but he is also looking at it from an entirely different perspective. Because of his role in the operation, his primary responsibility as the engineer is to get that train over the railroad. Although you are important to that engineer, and, of course, he is concerned about your safety, he expects that you will protect yourself against him. In other words, he expects that you will see him and get out of his way. That aggressive approach means that by the time he realizes that you don't see him or that you don't intend to get out of the way, it's often too late.

Even if the engineer views the situation in the same manner as you do, he still may not notice you. After all, his attention is directed towards looking for signal indications, reading orders, keeping an eye out for gate jumpers at grade crossings. At 70 mph, he is traveling 102 feet every second. By the time he notices the little yellow or white hardhat, he may have about 800 feet. Now with the red vest required by Roadway Worker, he may have 1,000 to 1,200 feet. By the time he notices that vest step out from behind the platform or signal bungalow, it's probably too late.

When it comes to coexisting with trains, we had better tell our people not to take a passive approach. The proactive approach puts you in the driver's seat because you control your destiny. Human frailty and other people's personal problems don't play a role in your welfare. You know, I image everyone in here is well familiar with stopping distances. However, when we talk to our people about these things, do we ever put it into tangible results that maybe they can relate to?

It's amazing how long it takes to actually get a train to stop. Let me throw out a couple of examples to make my point. Let's assume we have a 13,000 ton, 100-car unit coal train traveling 40 miles an hour. The engineer spots an emergency situation and he dynamites the train. Let's also assume that we have perfect conditions. Zero percent grade, dry rail, all new

brake shoes on the cars, and dynamic breaking. The locomotive engineer has his hand on the brake valve. How many feet do you think that train is going to travel before coming to a stop? Most of you probably know the answer. That coal train is going to take 17.6 football fields. Yes, that translates to one mile to come to a stop. At 50 mph, that same train is going to take 24 football fields. At 30 mph, it will take 12 football fields. At 15 miles an hour, and that's hardly fast at all, that train won't come to a full stop for almost five football fields.

How about commuter trains? They probably should be able to stop on a dime in comparison, right? A loaded 10-car commuter train under perfect conditions doing 70 miles per hour will take 3,550 feet or almost 12 football fields to come to a stop. At 20 miles per hour, it still takes two football fields.

Now let's apply a little high school physics here to get the basic momentum into the equation. The train's mass times its speed is offset by the employee's mass times his speed. The resultant if one were perfectly elastic will provide the employee with sufficient escape velocity to allow him to reach the farthest elements of the universe. I don't know whether you can see it or not, but it's over five million miles an hour. But then we are not perfectly elastic, so we evaporate. How about the basic kinetic energy equation? Take a look at it. That's 648 million foot pounds of energy. It has the same effect as dropping a 648 million pound weight on yourself from a height of one foot. The bottom line is you don't try to judge oncoming trains or engines. You control your own movement and style.

We just talked about movement factors with regard to train speed. When you are out there working on the track, you basically employ two personal factors, and you know this from Roadway Worker, to detect that a train is near you. This is vision and hearing. There are many environmental factors which can potentially limit vision or hearing or both and therefore limit your ability to detect movement of trains and other moving equipment.

I hope this has helped you to understand that each possible dangerous situation is a mixture of factors, some of which you control – personal factors – and some of which are outside of your control – environmental and movement. Working smarter means adjusting your personal factors to reduce the potential of environmental or movement factors causing an injury. However, it just ain't that easy. There has to be more to it than this. You know what? You are right, there is. Like anything in life, to make it automatic it has to be practiced diligently and religiously. Simply telling your people about these three factors won't do the job. We have tried it. It takes constant drilling by the supervisor to get them to employ it. What about Roadway Worker? Doesn't that supplant the need for all of this? But you know what, if you think about it, virtually every provision of Roadway Worker is built upon somebody doing their job properly. When that doesn't happen, the protection provided breaks down, doesn't it? Although we all continue to stress the importance of first and foremost protecting yourself and your personal responsibility, it's only natural that they are going to assume that protection is there when in some instances that protection may have broken down because of somebody else's personal problems. Now more than ever, our people need to be keen. Thank you. (Applause) .

Mr. Carter: Thank you, Joe, for a dynamic and timely presentation.

Our next presentation is Union Pacific's Automatic Blast Painting Facility and the presenter is Ted Haskell, manager special projects for the Union Pacific.

Ted earned a Bachelor of Science degree in civil engineering from Michigan Technological University in 1980. He began working with the Missouri Pacific in June of that year and worked in various locations as an assistant roadmaster. He worked for the Union Pacific until 1994 when he was assigned as manager special projects headquartered in St. Louis, Missouri. Please join me in welcoming Ted Haskell. (Applause)

UNION PACIFIC's AUTOMATED BLAST PAINTING FACILITY

Ted Haskell

Manager Special Projects
Union Pacific

Thank you. Union Pacific's new blast and paint shop is located in DeSoto, Missouri, about 35 miles south of St. Louis. The size of the shop is 720 long by 30 feet wide, 46 feet at the compressor and paint storage room by 33 feet high, 63 feet in the auto blast room. This building contains all the equipment to blast and paint a car in assembly-line fashion. The building is supported by 182 H-piles, 14 by 89s. All holes for piling were prebored and socketed at least two feet into rock and back filled with concrete and sand.

The building contains 12 overhead coiling doors, one at each end of the building, for the rail cars to enter and exit, one is located at the blasting area to supply blasting operations and one is at the paint prep room for maintenance purposes with eight blast resistant doors in the paint storage area. The building houses three new 600 horsepower 2,600 CFM air compressors that provide abundant oil free air throughout the new and old shops. Heat is provided throughout the building either by gas fired and radiant heaters, unit heaters, makeup air units, and heat recovery from both the air compressors and drying oven. There are 17 exhaust fans hooked up to 34 louvers to aid in air circulation.

The building is lighted with 170 overhead lights not including 146 light fixtures in the manual blast and 256 light fixtures in the paint booth. The building is fire protected with a wet sprinkler system everywhere except in the paint storage room where a dry system is in place. There are breathing air drops torque stations and welding outlets throughout the building. Also there is one office, one locker room, and two bathrooms for use by the 10 employees who work this shop at present.

Cars enter the building from the north after being released from the repair facility. The blast prep room is the first room of the shop and the car is dried and prepped for blasting here. Inside there are two sets of overhead radiant heaters that both dry the cars off and heat the car's skin for better paint adhesion. There are also drains built into the floor for water runoff. Cars move through the shop by way of a floor-mounted air wench located at the south end.

After leaving the blast prep room, a car puller engages the car and it starts through the auto blast booth. The car puller is a drag type conveyor that moves the car through the auto and manual booths with speeds ranging from 2 to 20 feet per minute. It is also reversible.

With the leading end of the car inside the booth, the oscillating panel starts and abrasive flow begins. Depending on the car configuration, abrasive flow may be shut off to one or more pairs of the blasting wheel units. Oscillating panels may be positioned to dwell on the leading and trailing ends to maximize blasting efficiency. The car puller is able to index and dwell as required for each end of cleaning and for heavy paint removal. There is an oscillating panel on each side of the booth and each panel contains five blast wheel units. The two bottom wheels are equipped to clean the most difficult areas. Therefore we use the 17-inch diameter wheel that delivers abrasive at 340 feet per second. The other three wheels are 15-inch diameter and deliver abrasive at 300 feet per second. Each panel covers through a 60-degree arc while blasting. There are also two blast wheel units mounted on top of the booth and these are also 17-inch diameter wheels. This booth is also equipped for internal blasting.

The rail car is moved to position the first hatch under the boom wheel. The boom is lowered through the hatch and abrasive descaling begins. Blasting continues through a

determined routine of vertical travel and clockwise and counterclockwise rotation. After completion of the routine, the boom is raised out, the car moved forward, and the process is repeated in the next compartments. The wheel blast boom is attached to a wheel carriage assembly that can traverse vertically 15 feet and 36 inches horizontally. This feature is to accommodate cars having off-centered hatches. Steel grids supplied with 55-gallon drums are used exclusively in the auto blast area and are added to the system through a gravity feed spout.

After the auto blast booth, the car enters the manual touch-up booth. Each side of the manual touch-up booth has a fully automated man mover for touch-up blasting. Each side has two blast hoses that are festooned to four direct pressure air blast tanks. Abrasive is fed from a 400 cubic foot storage bin to the blast tank. Each pressure tank can blast continually up to 60 minutes. Each tank has a mixing valve which mixes abrasive into the pressure tank. When blasting stops, the filling valve opens and abrasive flows from the hopper refilling the tanks. It takes approximately one second of refill time for each blasting minute.

Inside the booth are breathing air lines and 146 light fixtures to aid the employees in their work. Under the floor of each blasting booth are screw conveyors that reclaim the sprayed abrasive for reuse. The used abrasive is carried up the belt bucket elevator and discharged into a rotary scalping drum. After coarse refuse is screened out, the used abrasive and fine refuge falls through an air wash magnetic separator. The air wash separator zone is 12 inches high to allow space for efficient separation of good abrasive and fine refuge. There is a primary skimmer plate that removes the fine refuge while the secondary skimmer plate directs only good, usable abrasive to a 725 cubic foot storage hopper. The material is distributed from here through gravity speed spouts to the wheel blast unit. The fine refuge is delivered to the storage hopper feeding the four blast pots. The pneumatic conveyance system used to supply and return media to the shop is also tied into the two existing blast booths. The conveyance line size used is four inch schedule 40 steel pipe. All elbows and blind tees are schedule 80 steel. Running parallel with the conveyance line is an inch and a half air line with injector nozzles attached that help keep the media flowing.

To supply the new and old shops with blasting media, a rail car is used. The product is then conveyed to the supply line by way of two separate diverter valves making sure all three shops have adequate product. At the return site, each side has its own pneumatic conveyor that cycles waste to 1,000 cubic foot storage hopper for off-site disposal. This system requires 100 psi of clean air for operation.

After the car leaves the blasting area, it enters the paint prep room. Here the car's trucks are covered and moved into position to get painted. The car travels through the area by way of an air-operated wench located at the north end of the booth. At this point the car enters the paint booth. A car travels through the booth by way of a rapid conveyor, same as the one in the blast booth. The paint booth is 110 feet long by 21 feet wide and 28 feet high with 16 by 21 foot roll-up doors on each end. Each side has a fully automated man mover with an airless spray station on each lift. Each man mover is provided with a festooning system complete with four roller trolleys. The booth has four man mover doors and 256 lights to aid employees in their work. A down draft type ventilation and filtration system is used in this booth. Mounted in the booth ceilings are standard 24 by 25 inch inlet filters. The exhaust filters are attached to the vertical walls of the track to support pedestals and are a roll-up media with a backup filter behind. These filters have a 99.8 percent efficiency at five microns. There are four 36-inch variable speed auxiliary exhaust fans that provide 80,000 CFM to either be exhausted to the atmosphere or recirculated depending on usage needed. Also there are three vertical make up air units all equipped with power variable inlet dampers with a capacity of 80,000 CFM of heated air or 8,000 CFM during recirculation mode.

Supplying the paint booth with paint is accomplished through numerous insulated steel lines festooned from the paint storage room located directly east of the paint booth. Inside the paint storage room are four two-part epoxy component pumps, three high pressure water boring pumps, and one each solvent and water flush pumps. Everything in this room is Class I

division blast resistant. The two-part epoxy system is used mostly on roofs of tri-levels and inside of hoppers. The epoxy pump units are a one-to-one mix ratio of sixty-to-one pressure ratio. Two units are dedicated to each man and each unit is complete with a heated holding tank. Tanks have a stainless steel inner tank with explosion-proof heaters that are thermostatically controlled.

Each hopper maintains an agitator and level control. The level control allows materials being pumped to run automatically during a shift and maintains full levels in the heated hopper at all times. Heated hoppers not only precondition the paint, they also provide a 50-gallon buffer to the spray unit when changing tote tanks. Each component pump has a regulator, control assembly, fluid outlet manifold, relief valves, and two each high pressure in-line filters.

There are three water-based paints being used in this shop at present, red, gray, and white. Red is used on gondolas and box cars. Gray paint is used on hoppers, and white paint is used for the inside of box cars. Each water-borne pump is complete with regulators, assemblies, and inner connecting hoses. Each unit has one 4,000 watt high pressure in-line heater and the units are 56-to-one pressure rated.

After the car is painted, the car is pulled into the drying oven by way of another air-operated wench. The oven is 100 feet long by 21 feet high and 17 feet wide with overhead coiling doors on both ends. The oven is made of 16 gauge galvanized steel with two-inch thick mineral wall installation. Two pounds of natural gas is used to run the gas train. The burner has a maximum of 2.4 million BTUs to get a 200 degree Fahrenheit discharge temperature. There are 66 catalytic gas infrared heaters placed throughout this booth. Each heater is mounted on brackets so they can be adjusted either up or down.

There are four 10,000 CFM recirculation fans in the oven with one mounted on each corner. Each fan is connected to 15 four-inch nozzle outlets that have control dampers to enable restricted air to various parts of the car if necessary. There is also a 5,000 CFM exhaust fan that takes air from the bottom center of the oven to a nearby heat recovery makeup air unit. The car takes about 45 minutes to dry in this oven.

The car next enters the last area of the shop which is the stencil room. The car travels through this room by way of an air wench mounted at the south end of the building. The car first passes over an 85-ton weigh scale. The scale is hooked up to a printer that records the date, car number, and weight of the car. The stencil room has the same type of man movers that are in place in the paint booth. All the stencil decals are stored in adjacent room for easy access.

Since the shop has been in operation, they are averaging eight cars in a 10-hour shift. Some productivity benefits already realized since the shop has been in operation are as follows: A 60-foot box car which used to take 22 man-hours, now takes 14 man-hours. A C-4 hopper which took 18 man-hours, now takes 12 man-hours. A C-3 hopper which took 15 man-hours, now takes 11 man-hours. Interior blasting of the C-4 hopper used to take 16 man-hours and now just takes three hours.

Environmentally is the area where cost savings are most significant thus far. The shop uses water-based paint exclusively reducing the volatile organic compounds or VOCs dramatically. There is also no waste of which to be disposed. Any paint residue is returned in totes to the supplier. Blast media, both steel shot from the new blast and black from the old blast, are being recycled to a cement plant. Prior to this, it was disposed of in 55 gallon drums, one per shift at $400 per drum. Now we are paying $8 per drum saving about $350 per day.

With that, I would entertain any questions that you might have. Otherwise, thank you very much. (Applause).

Mr. Sensing: Thank you, Ted. I have a certificate of appreciation I would like to present to you. Thank you.

If Dave Crader is still here, please return up here also and receive your certificate of appreciation which we weren't able to do this morning.

We now have another general legal announcement to all voting members of the AREA,

Roadmasters, and B&B Associations. If you have not previously submitted your proxy for the merger vote to be held at 12:00 noon today and wish to vote, please see the gentleman from Corporate Election Services, Mr. Johnston, at the table outside this room before the start of the special business session at 11:45 a.m. today.

Our next feature will be Mr. John Rinard, vice president with the engineering firm of Daniel Mann Johnson Mendenhall out of Los Angeles where he serves as director of rail. He is a program manager for the Alameda corridor project which was a $2 billion project to improve rail access to the ports of Long Beach and Los Angeles.

Prior to joining Daniel Mann Johnson Mendenhall, John served nearly five years constructing Southern California's regional rail commuter rail system known as Metrolink. Before that, John served nearly a decade with the Southern Pacific Railroad as assistant division designer of track at San Antonio and interim district engineer during the reorganization in Dallas. He served as construction manager for the Eastern region and several projects in the western United States.

John is a member of the Roadmasters Association, the AREA, and is a registered professional engineer with a Bachelor of Science degree in civil engineering. Please welcome John Rinard. (Applause) .

ALAMEDA CORRIDOR PROJECT

John Rinard

Vice President

Daniel Mann Johnson Mendenhall

Thank you, Andy. To give you a little bit of background to the Alameda Corridor Project, it is named Alameda because it parallels a street called Alameda south of the City of Los Angeles between Los Angeles and Long Beach and between the connection of the freight railroads that connect all of our nation's railroads that are represented here. It is a project that has been in the making for many years and has now seen a green light to get started. I think it's pretty exciting with what we have learned to love in our railroad standards.

How do you apply railroad standards to a major billion dollar construction project? My point here is to show you some of those challenging standards on how we put them into this project; in particular, a deep trench which is what the heart of the presentation and project will be about.

As a little background to give you some of the economics of where this project happens, the ports of Los Angeles and Long Beach represent the primary U.S. gateway. They handle 30 percent of all the water-borne cargo into and out of the United States. They represent the third largest in the world and the largest in the United States as well as what has happened since 1990 with the freight movement to and from those Ports has already increased 42 percent. It is expected to double by 2020. The freight will also expand 105 million metric tons.

How do you handle that demand from a railroad standpoint? That also represents $173 billion in trade annually to the nation.

I have a little bit on the regional benefits here to show you that this project does affect all of the roads represented here. In the western United States, for example, that trade is $64

billion with 1.2 million jobs impacted from that and state and local tax revenues of $3 billion. So you can see why the public agencies are interested in that.

In the central United States, giving you additional statistics, there is $7.8 billion in trade which is again almost 200,000 related jobs, and $400 million in state and local tax revenues. The eastern side of this is $43 billion, one million jobs and another $2 billion in tax revenues. As a wrap up across the nation and why this is so important and what we have tried to sell about the corridor, the nation as a whole has $1.16 billion value of trade that would operate through those trains that carry through the ports, with 2.5 million impacted jobs, as well as $5 billion in tax revenue to the nation. So that's what has the federal, state, and local government agencies interested in this project.

What is the project itself? On this map, Los Angeles is underneath the word "Alameda." It's about 22 miles from the water's edge which is the south end. All of those lines are railroad tracks of one sort or another dating back over a century. There are four lines which are essentially the bottom lines to the south. The red dotted line is the selected corridor route. The idea was how do you then increase the throughput of the ports economically, as well as get that freight onto the trains quicker, and then get it to the connection of the railroads across the nation. It will consolidate those four rail lines in this one corridor. Where there are over 90 miles of track today, it will be put on this one 22-mile project itself. The trains today are exposed to 200 grade crossings in this location. If you have ever been to south L.A., you know most of them are jammed to capacity already. So it's really kind of squeezed down the flow of freight through that area as far as speed.

The selected corridor is in a primary industrial area. It's the easiest grade alignment to connect to our railroads, the corridor with double track with C.T.C. In fact, I will talk a little bit more about this as it may end up to be triple track for the maintenance track with the local drill track. The central part of this will be in a depressed trench 10 miles long below grade. The local remaining lines will be left for the local freight or the wishes of the individual railroads.

Originally the roads of Union Pacific, Southern Pacific, and the Atchison, Topeka, and Santa Fe were involved. Now obviously those have been reorganized into the Union Pacific and BNSF. These roads will play a major part in reviewing and implementing this project. The agreements that the project worked under will be AREA standard as well as the individual standards of the roads so it's things to which people in this room are quite accustomed.

To give you an idea of the train growth in here, the train activity in 1990 was something around 35 trains a day. In the year 2000, it's expected to be over 60. By 2010, it will be approaching 80 to 85. By 2020, it should more than double to 100 trains a day. That is a full length loaded in excess of 10,000 ton freight trains whether it be intermodal, coal, or any other commodity operating through this facility.

The agency is called ACTA, which is the Alameda Corridor Transportation Agency, and the members are the Port of Long Beach, the Port of Los Angeles, the City of Los Angeles and Long Beach and the Los Angeles County Metropolitan Transportation Authority. They make up the owners, if you will, of this particular project. The program management of it is a joint venture team. Now everybody has an acronym these days, and I represent DMJM. Jenkins, Gales, Martinez; Moffatt and Nichol, and Telacu Industries make up the program management for the project itself to implement that. The two ports have tremendous capital projects themselves so they reached out to a program management team to implement that without having to extend their staff for a finite life project.

The scope of the work to date has been to select the conceptual alignment and designs for that and proceed with the selection of a design/build contractor who will do the final design and build at the same time.

Some of the corridor challenges include the fact that it's approximately $1.3 billion in construction costs in today's dollars. How does one deliver that? One of the biggest challenges with that is that it's restricted by the sources of money and obviously interest on that money.

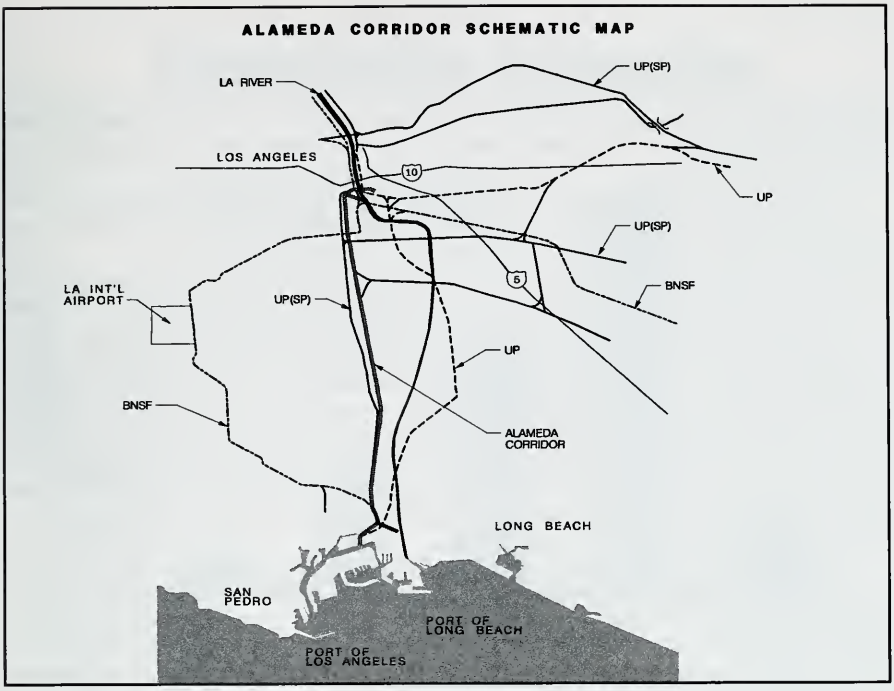


FIGURE 1

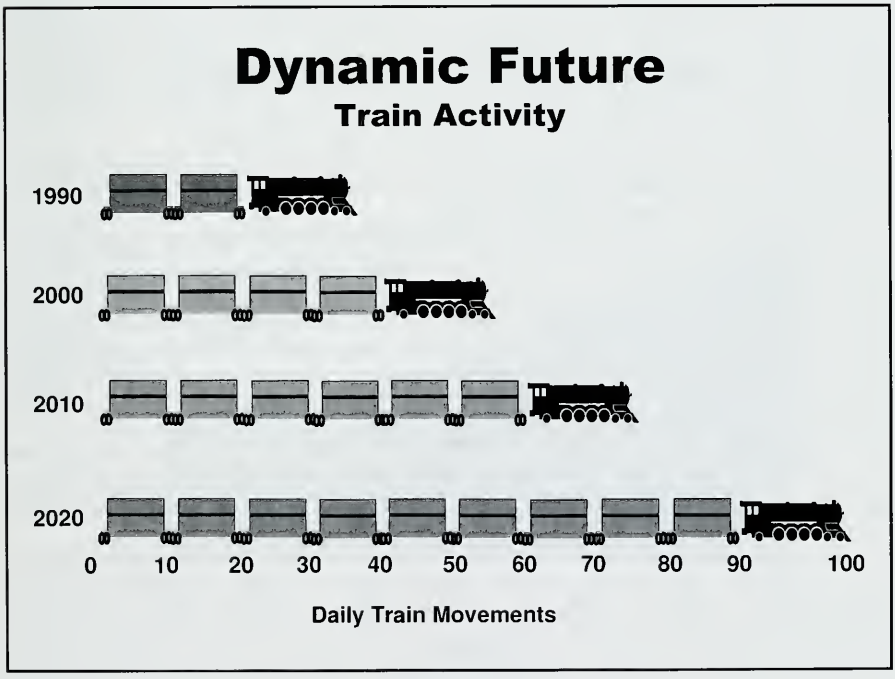


FIGURE 2

So how does one put that much money into the ground in a new facility like this in the shortest amount of time? It's not one project that is getting dictated by the best engineering and management, but probably by financial constraints and then asking railroaders and engineering to deliver that need.

It currently has a political three-year implementation request schedule so the idea is to see how fast we can get it done and can we get it done within three years. You'll see a little bit more on the flow of that cash a little later.

It also has 152 utility companies that are impacted and has multiple lines along just even a 10-mile stretch that is a trench section as well. It lies within six corridor cities that are south of Los Angeles so you can understand the traffic impacts would be quite extensive.

Time, value, and money. The plans envisioned with the railroad agreement when the Ports purchased this right of way from them some years ago envisioned a careful approach wherein we would build the north and the south end of the projects first, not disturbing the flow of traffic, and then taking a mid corridor out of service and rerouting the trains. We would then build the depressed trench. Because of that value of money, the request is back to the railroads with discussion going on even as we speak to determine to do this all at one time. Therefore, again, it's value of the money, not necessarily the best management that we would come up to. It's a finite budget in light of the tax situations.

Everybody has heard that there is a $400 million federal loan. The Ports of L.A. and Long Beach expect to sell $700 million worth of port bonds. The county itself is chipping in approximately $350 million worth of donations to the project. So it's a mixture of sources of funds and, of course, most of that is paid back by our railroads who then pick up the freight at the ports and shipping lines who then pay a container price or unit basis to the ports for that service of receiving or delivering the freight.

The schedule right now is between 1998 and the year 2000. That equals about 1,000 working days within this schedule. So given that completion schedule, again, this is the request of the agency, how does that envision on a normal expenditure. Well, you will notice that it's quite severe as it reaches the year 2000 on the cash expenditures. That would be a peak month if you can carry this off with a mega super turnkey contract, a peak month of $70 million of construction paid out the door. So it is a huge project. A peak day would be $2 million plus and an average day of $1.3 million. So you can see it's quite challenging.

Here's a little capsule on the tonnage. We can then talk about the technical detail. In 1990, it was about 70 million tons a year. It has already increased 102 million tons by 1996. That is expected to double as we proceed into the future.

The grade separated section which I will focus my points was, again, to show how those standards are going to impact us on the project and how it reaches out to all of us here. This line is planned to be a 40 mile an hour line. Now we call it a high speed line probably for most of our political constituents, but today it operates at 10 to 20 miles an hour. So the planned 40 mile an hour would greatly increase that. The only restriction on that speed is obviously the curves at both ends and the fact it is reaching the water's edge. So the greatest benefits as seen is performance of having a grade separated line unencumbered by those highways and not necessarily a very high speed line itself.

The corridor will be designed to carry double stacks and unit trains operating today and of course every road in this room is carrying freight that comes through these Ports. You might not have realized that, but it does reach all of us. We will all be challenged as our systems mature with projects, I believe, like this across the nation.

The trench itself is the single significant feature of the project. You are looking at downtown Los Angeles on a clear day at the top of that picture. Our backs are to the Port of Long Beach and what you see in front of you is the alignment that is Alameda Street. It has a left and right side highway on both sides of this corridor. What you see is a computer-enhanced image where the trench is actually completed. You can see all the cross streets. You can see the heavy industrial area and some limited residential area, not necessarily adjacent to the project

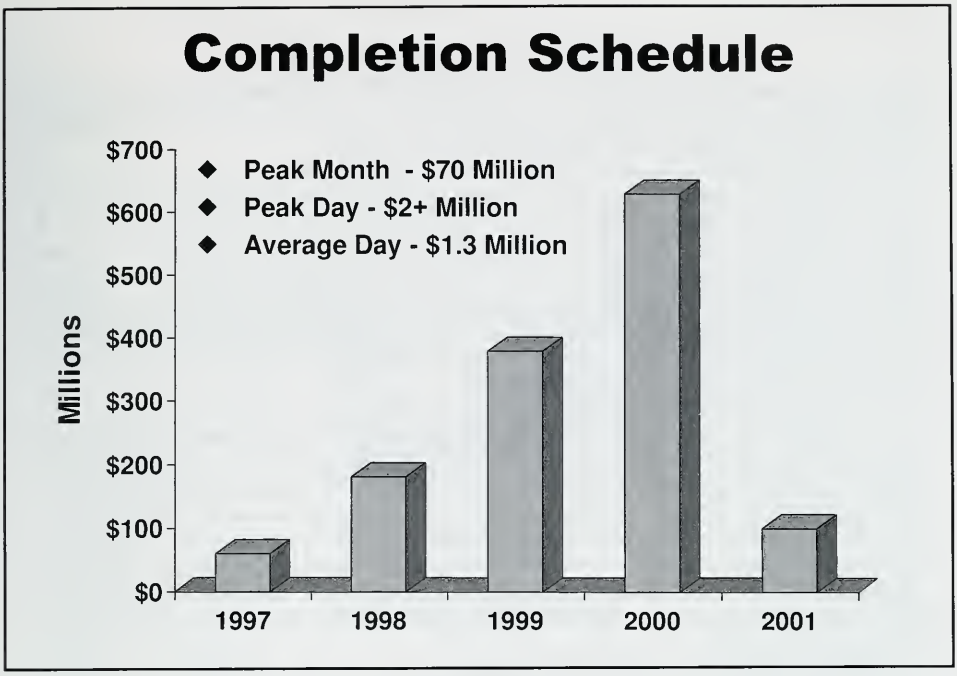


FIGURE 3

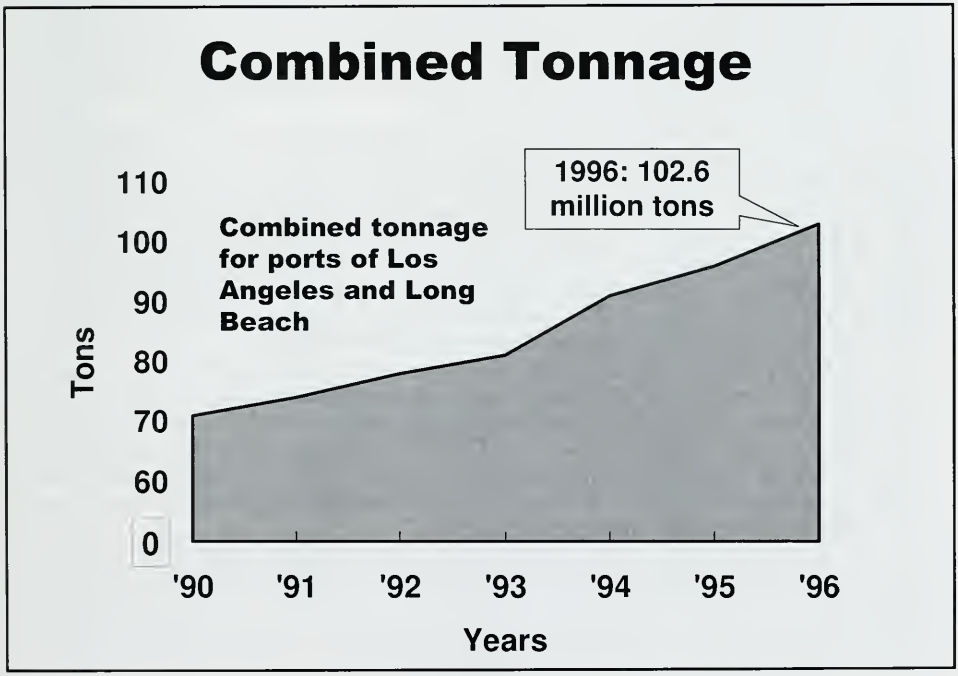


FIGURE 4

itself, but it traverses through these six local cities and has 26 locations where the cross highways need to be constructed across the top of this. As I mentioned, they were a jammed capacity. So again, there was a lot of phasing work to do that.

The plan is to advertise a design/build contract. What that primarily means is design with the construction in January of next year. That option has been jumped because of the value of the money again. So design/build has a lot of definitions. We have heard about the BOTs and BLTs and it sounds like a food chain. But in this case, it is final design with the construction allowing or really turning the control over and making the final design details to the builder. What we are normally accustomed to is spending a lot of time in the early design and planning phase of that. This really would be handed over to the builder itself and then let them worry about that. We would basically put together a performance specification much like you do on high-rise buildings. There is a customary there.

The project calls for completing the design of the tracks and signals and certain cost drivers or those issues that really are hard to have a contractor to get his hands around. Those typical things include utility locations and you can imagine going down into a deep trench how difficult it is to deal with the utilities. Also included is the traffic management on left and right sides and working with the local cities and the 26 highways. As far as the technical on the actual design itself of a deep concrete deep trench like this, that's not really a cost driver. It's big, yes, but it's not a cost driver. Any contractor tomorrow could estimate that, but a contractor has a difficult time estimating the soft side of projects like traffic management handling and utility relocations where there are third parties dealing with that. So those are really what we mean by cost drivers.

The trench section itself is, I think, where the challenges come. It consists of a standard double track section today with a parallel maintenance roadway down in the trench. It's approximately 35 feet deep with vertical sides and a 50-foot wide clearance. A 24 foot 8 inch overhead clearance is planned out which should allow for electrification should that come. Access is planned at either end of a 10-mile stretch to obviously restrict trespassing and those kinds of problems. The alignment is relatively straight with one to two degree curves on multiple mile tangents. The grade falls at pretty much a constant one percent from end to end making it simple in that respect.

The trenches were envisioned today again. The design/builder can select the application and the thought was that it's envisioned to have a concrete invert that you can see below the track. Obviously because of exterior water coming into the trench there's the issue of how do you control that as well as how you brace those sidewalls to keep that clearance left to right as wide as it should be. It really resembles a tunnel without a lid. So if you have worked in and around tunnels, you will know what the challenges are with safety and maintenance of way and even construction and capital rehabilitation projects. So consider it a tunnel without a lid. Obviously if you have a top we can't reach down there with cranes and those kind of things, but we still have the same side clearance issues that we do with tunnels.

For the side clearance with a 10-mile continuous trench, we typically can't look at what we usually do. In many of the other slides you have seen we are looking out of a tunnel or out of a large structure and you can always find a wide spot where we can have work areas where the right-of-way widens out and gives us the flexibility for equipment and other needs. Here we must consider those issues in the implementation of the project because where does your gang stand when all of a sudden you have two trains on both tracks. So those issues have to be determined on the early end of this particular project.

The trench is designed 50 feet wide with the incorporation of a service road with side rings to either side trying to stay away from piping and other systems like that. The ballast can plug up. Assuming that the track section is a standard western railroad rail tie and ballast section, but trying to build a system that is easily maintainable. So those issues and what I am

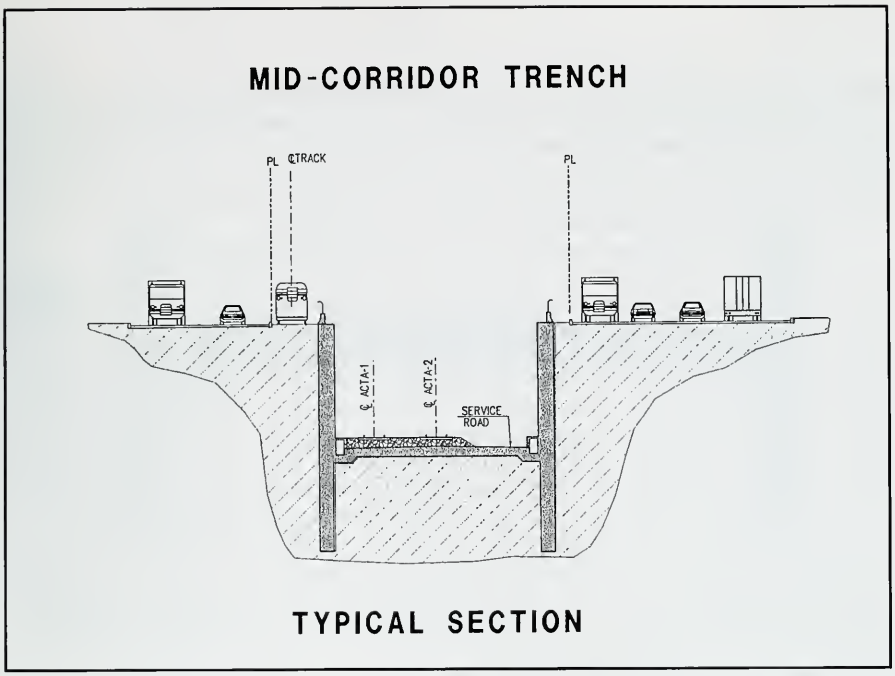


FIGURE 5

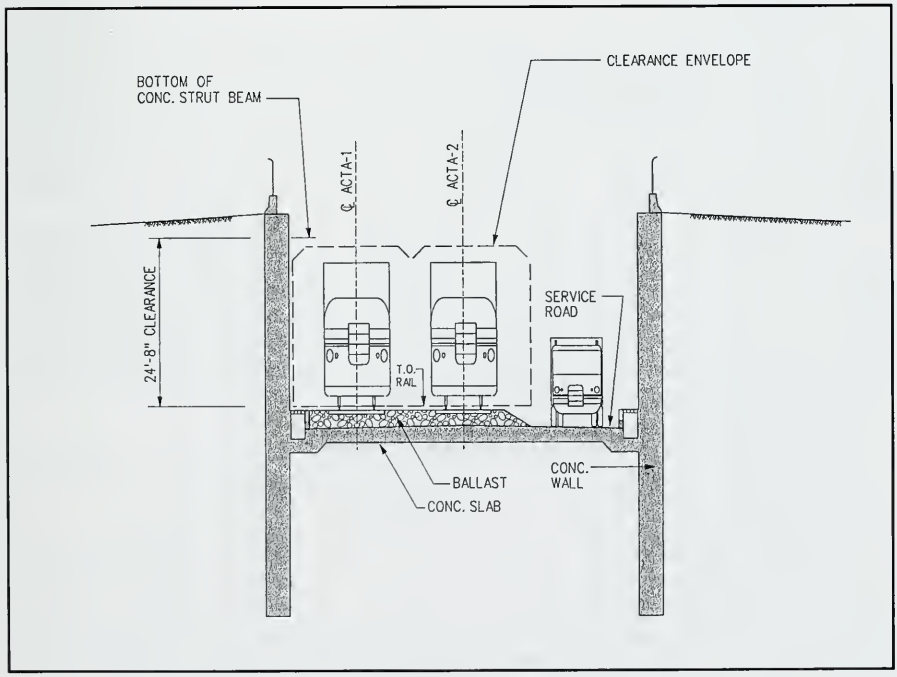


FIGURE 6

showing you here are some ideas and not necessarily what will actually be built.

The third track is obviously an option. There is a lot of discussion right now because with that being a maintenance track with 100 trains a day, how does one get track time to do anything. The roads are looking right now at what to do with that. I would not be a bit surprised if we end up with three tracks. So then there is the issue of maintenance of way via on track equipment instead of having a maintenance road parallel to it.

Again, those are drainage systems and we will talk a little bit more about that.

We think it will incorporate a strut system at the top of the box. The reason for that is that underneath those highways to the left and right side of the picture are major utilities underneath the street. It seems like storm water sewers and sanitary sewer systems. If we did a typical spread footing system with tie backs, you are going to have to relocate those or really engineer around those which would be quite difficult. So the thought at least in our early planning is to get the design builder to look at a strut system with a strut that can be 15 to 25 feet on center still giving you access from the top and possibly even being able to remove one strut at a time for emergency access. Therefore you basically have a box so you can imagine the engineering design with the invert below would be a stiffening member and the strut above. You have yourself a complete box in there without the tie backs and the spread footings.

You will notice the sidewalls go down deeper on the side. The thought there is with construction. How do you construct a box with struts in it where the side walls have to take the load early before you get your strut in place. So the idea is, and the reason those footings go straight down deep, you have to go in deep because you can't go with spread footings and go out. So again, it's a design element that has to be looked at, but struts, we believe, will be one of the issues that will be of interest on this project.

You can see how the struts are envisioned to be across. I don't know if there is a cast in place or a precast but, again, it kind of gives a typical layout of what we think could happen as we look at the project today.

The current design shows the trench drainage to be managed by opened up ditches on both sides; however, trying to stay away from the trenches and the piping themselves. The original line was a line dated back over 100 years and actually was used for horse-drawn wagon freight that used to run from the ports up into what was the Los Angeles area. There were cornfields on both sides in fact. It migrated to the highest point out there to stay up out of the mud. There were also the larger dust problems. So we think it's in a pretty good location. Of course, we hope there's not an Indian burial ground or anything like that down there. It will be interesting to see.

The track section itself, I think, is the heart of this presentation. I have already talked about the fact that it's at street grade, so obviously the street service grade has to be maintained. You have 26 cross structures so depth of structure is something you can't play with too much. You can wear out your engineers and squeeze six inches out of a bridge deck, but you certainly can't take four or five feet down to six inches. You also have a mandated 24 feet 8 inch overhead clearance from the top of rail. So now you are down there 30 to 35 feet. Of course, the deeper you go, the wetter it gets. The deeper you go, the greater those side walls are and the deeper that inboard is and the greater the excavation is.

The excavation on this job is three million cubic meters. It has to be metric because of those federal dollars. There is a lot of excavation and the deeper we go the more problems we have. We are right at the water table edge on the south half of the project as it is.

So what do you do with your track design? Well, typically we like, and the road where I was taught likes rail ties with nice, good, thick, clean ballast. Good dressed shoulders, and a drainage ditch on both sides with maybe even some scorched earth outside of that is romantic. Well, in this particular case, how do you place that into a deep trench? Well, you start looking at things like the side drains that you can get a shovel into. You start looking at the only variable in this case which may be your ballast section. So do you put in a couple of feet into ballast or do you put a CAV on top of that? Of course, you're sitting on top of a concrete invert.

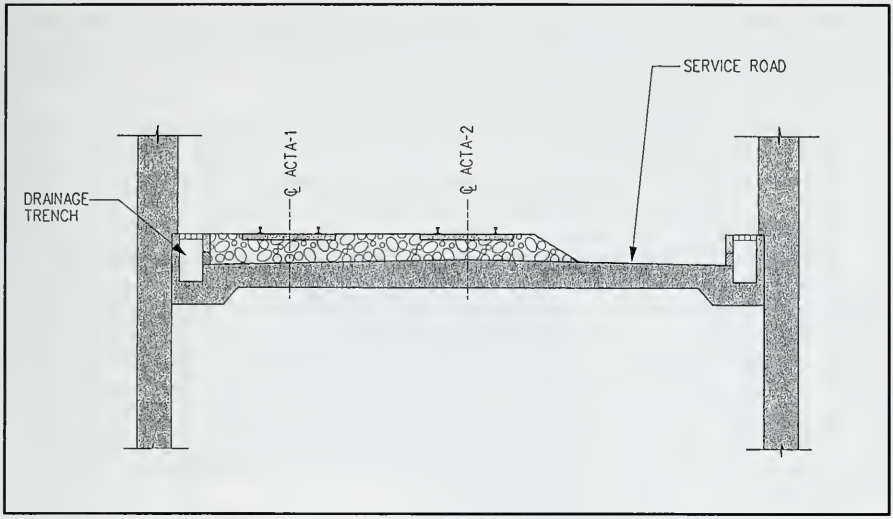


FIGURE 7

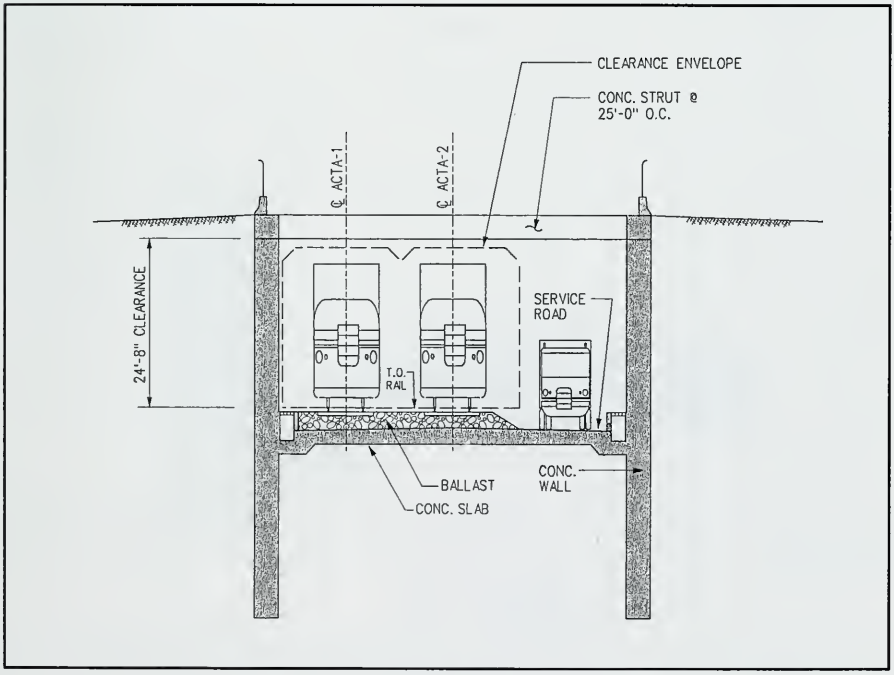


FIGURE 8

We know what some of our problems have been with the quality of ballast and how it degredates between a concrete tie and a concrete bridge deck. What do you do in this in case when you have ten miles of this down in the deep trench? You don't have a place to cast that material off to. It's going to be expensive to haul it out of there.

So, again, some thoughts at this time is what do you do about ballast mats? Do you take a look at some direct fixation or some slab track? Those kinds of things come to mind and probably will be things that the roads will be wrestling with as they look at this in the future.

So that I think is key to this and where our standards don't necessarily directly fit into a 10-mile long deep trench situation.

I did do a little analysis on the issue about depth of ballast section underneath this new track and the cost of the structure itself including the sidewalls, the excavation, and all of the other issues. So the engineers put together this chart. You will notice that even if you go to 24 inches of ballast, it's still around $70 million or $80 million total cost to the project. However, if you have to push it down 24 inches you will notice the top line on that, the red, reaches up to $300 million cost to the project because of the track section. So I think that points out the need to look at how our standards are applied. We are not saying that's not what we will build, but I think it sure makes us revisit those things. As some of our port connections and inline points have to develop projects like this, we are going to be faced with the same challenge to our standards. We may have to revisit some things.

With the environmental agencies along, how do you handle drainage in the trench? Well, at the south end of this 10-mile long section, there was a creek so obviously we would like to string right into the creek. But the environmental group said that wasn't going to be the case. So we envisioned having two or three of these pumping stations where there is a reservoir below track grade. That may be the funkiest thing I have ever seen around a railroad, but how does one solve the drainage of that directly overhead run off material as well as the environmental agencies concerns about spills and run off of that nature? Now, if it's unsafe where it's working at grade and it's going below grade in the future, this is obviously a greatly improved system where it's contained and brought forward. So in this case, that's one of the wilder ideas of this project. Again, we have to address drainage so I am open to any ideas.

With respect to clearance, what do you do with communication and signal systems? How do you put them in this box? I stuck in there how can you hang the signals in the clearance spot between the tracks, but where do you put the signal bungalows? Where do you put the signal itself if it can't go overhead. Where do you put the line of sight for radio needs and what about the line of sight for the train engineers themselves?

Well, it's really easy as this picture shows. We will just put out that right wall several feet. However, realize that wall is 35 feet down to the roadway and it goes deeper than that. So that little bungalow location just probably cost us several hundred thousand dollars. It's also underneath the highway so it's cantilevered back over the top. So even the simple bungalow location becomes a critical point.

Placement of not only the signal bungalows but the vehicle passing points is important. So if you have a one-way maintenance roadway down in this trench, how do you pass the signal maintainer with the track maintainer's truck that's over on the roadway? It may be simple, but in this case, it's challenging.

Many of you have worked on railroad causeways. I was talking to Jerry Murdoch this morning about the Great Salt Lake Causeway we worked on. Well, on that project it did have a passing point every quarter or half a mile where you could pass maintenance-of-way vehicles. Well, I think something like that probably has to be incorporated into these types of big projects as we look below grade of the railroads.

I guess one point I didn't mention earlier on as I know most of us in this room typically don't move railroads; we typically move the highways up or down. Well, the economics was it was cheaper to lower the railroads than it was to buy all the properties in the industrial areas to cross over 26 of those highways. So that's why we have taken the reverse from what we customarily do.

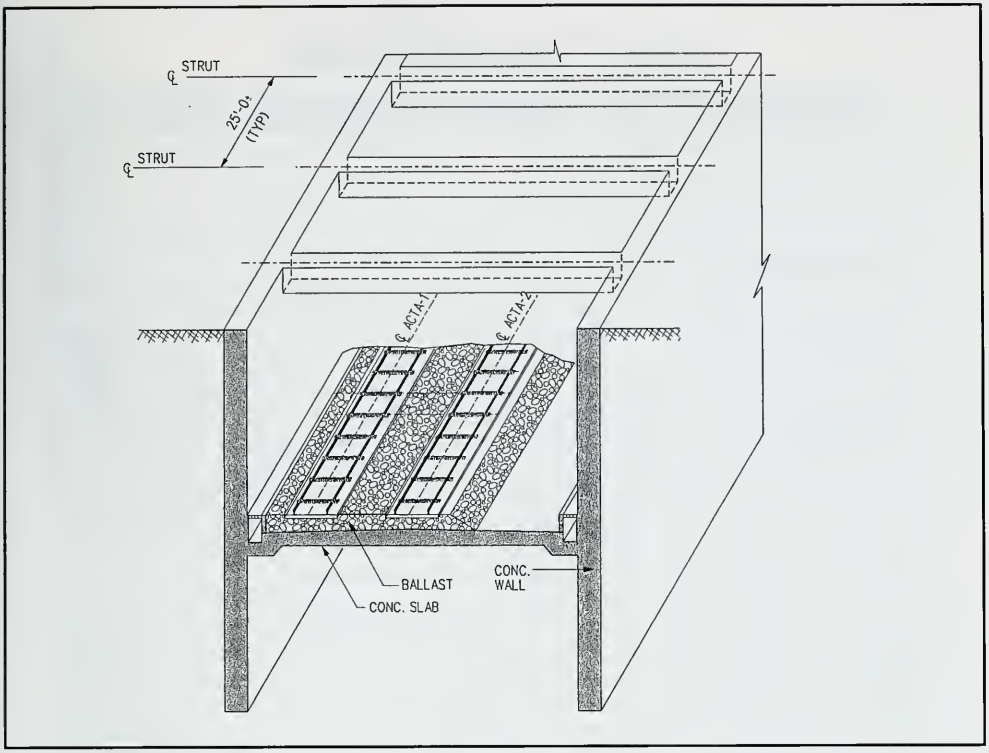


FIGURE 9

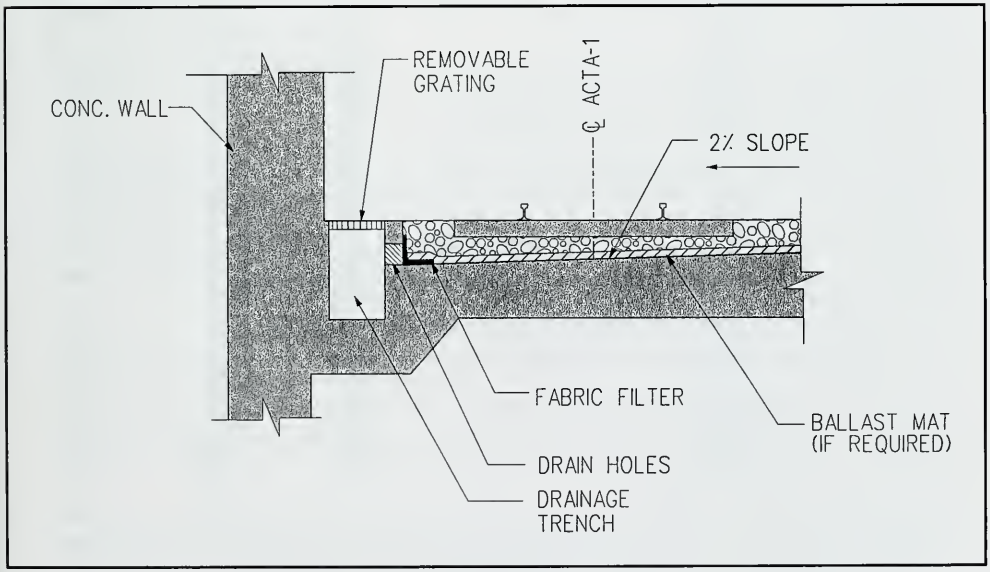


FIGURE 10

Safety is key in the project. You are going to have workers out there. These are a couple of pictures of the north end construction. We have the Los Angeles River bridges and two other bridges coming on line now that are outside of the trench section. How do you consider safety for the long-term life, possibly 100 year future, of this trench to keep our men and equipment safe and in comfortable working conditions? You are down in this trench and you have a load of lumber coming down and the straps are flapping off the side. Where do you get out of the road? Do you build refuge holes in this particular case like tunnels? What else do you do? Then, of course, what kind of safety applications do you have for maintenance people down in this particular area? So safety needs to be part of this throughout every step.

Regarding security, you are through those six corridor cities and it's highly congested with a lot of people and a lot of children. At the top edge of that if you get your perspective, there is a strut overhead and then there is something like a vehicle barrier directly on top that would be for collision of cars or trucks at surface level. There's some sort of security fence on top of that. We have a low railroad track relative to the surrounding environment. It seems to me that everything comes to that railroad. Well, in this particular case, how do you keep it away? Fortunately, this tends to be a crowned area in the local environment, but I think key to that barrier would be how to keep it up so that any of that debris and garbage that tends to be dumped on our railroads doesn't get into that deep trench. Realize that's straight over the side wall 35 feet right down to the track. So it will be interesting to see.

What does the future hold? Well, I think we still need to stay with our basics across the nation. As you will see from increased Pacific Rim trade we are all going to be challenged with this. This is just one project example, I believe, of how many of the other ports and intermodal facilities are going to be challenged to expand. It's going to be a world class project of which we will see a lot of good pictures over the next two to three years as they solve some of these challenges. However, if we stay with our basics and our typical common standards and what we have grown accustomed to and don't make radical changes, our long and short-term access needs can improve to these facilities. The current railroad standards obviously are going to be challenged but what has been valuable about Roadmasters and B&B and AREA is we really try to prove why we should change our standards. Here is a good application of this that, again, just takes more thought and more committee work to determine what should be brought forward.

I think we have proven it works in the past. I think we will continue to be challenged as we go on and serve our customers and our clients. It's going to be fun to see how it's developed as we begin maturing into the next generation.

How does one deal with off-track maintenance-of-way gangs down in a deep trench? How do you handle your switch ties where you need a lot of room? Where do your men stay safe as they work through this? What type of other training facilities and programs should we augment the current programs we have to handle this special type of inline considerations? How do we keep the lone worker safe as well making it a safe working environment? I think these are all critical to what we have to do. How do we handle the material distribution down into a restricted access area like this for a long period of time?

I think the Alameda Corridor Project offers this group a little bit as what to see with that. So I think that you will probably see many more of these as we get some action shots. The time frame is January. They should put out the proposal bids for design/build work. We would hope by the fall of 1998 the contractors should be given the notice to proceed. The contractor is going to be under the gun for the schedule so there may very well be some dirt flying in 1998 on the trench section. The trench section will be the one big design/build contract somewhere in the area of $600 million alone.

So we should see some action shots definitely in 1999 and we ought to be able to see some of the thoughts that I have given you here and what is actually happening and what has changed. I don't propose this is what it will be, but I think it's something to take a look at.

So with that, thank you for this, Andy, and back to you. (Applause).

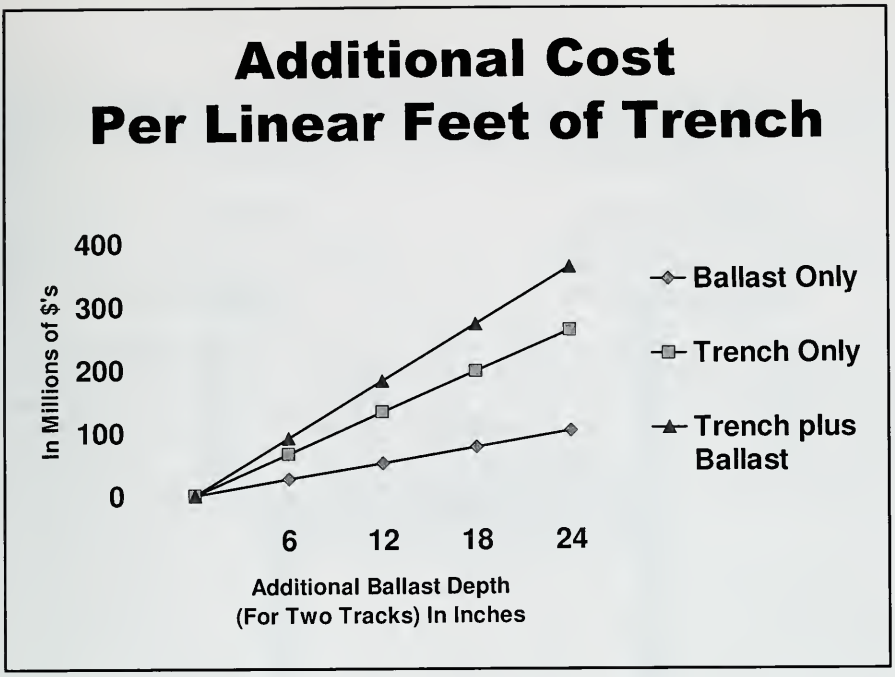


FIGURE 11

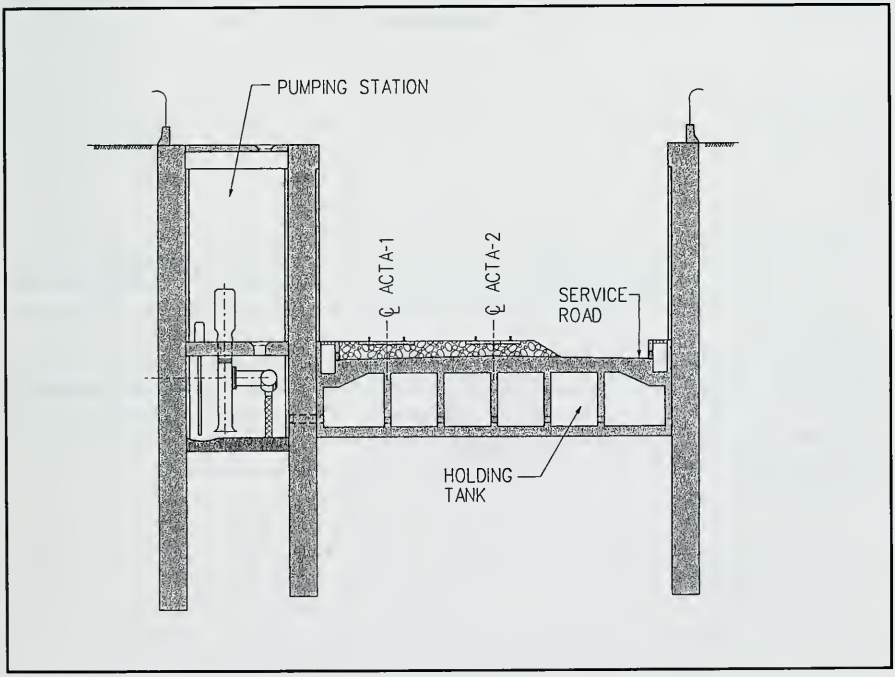


FIGURE 12

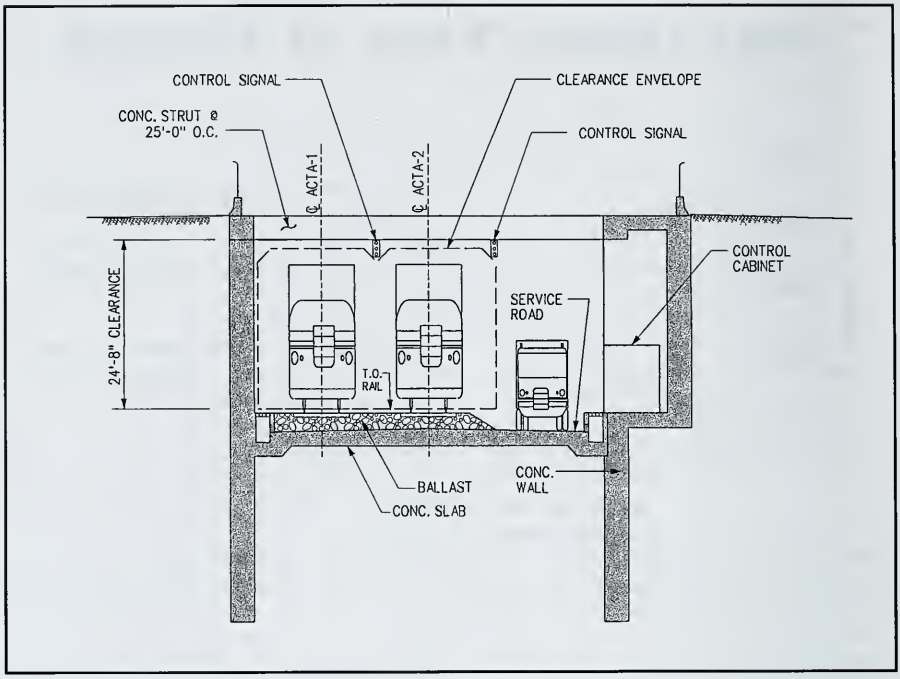


FIGURE 13

Mr. Sensing: Thank you, John, for that presentation. It was very interesting. Again, we spare no expense in presenting you with this certificate of appreciation and a Roadmasters cap.

Tom Long will now introduce our next speakers. Tom is a director with the Roadmasters Association.

Mr. Long: Thank you, Andy. Our co-presenters for Safety Improvement Trends in Maintenance of Way Equipment are John Blanchfield who joined the Norfolk Southern in 1970 and was promoted to his current position in 1993 as general superintendent of maintenance equipment; and also Dennis Sullivan, who is general manager contracting with Plasser American.

SAFETY IMPROVEMENT TRENDS IN MAINTENANCE OF WAY EQUIPMENT.

John Blanchfield
Gen. Supt. Maintenance Equipment
Norfolk Southern

Dennis Sullivan
General Manager Contracting
Plasser American

Mr. Blanchfield: Good morning. I certainly appreciate this opportunity to speak to everyone about the recent trends in safety in maintenance of way equipment in the railway industry today. During this portion of the program, I will not only address safety apparatus and equipment as developed by the various rail carriers, but also the close relationships and cooperation between rail carriers as users and original equipment manufacturers as suppliers. I will address the complete spectrum of safety appliances and apparatus. I will touch on ergonomics, servicing, operator protection, material handling and operator safety. While our focus most definitely is towards the future, we need to reflect to the past to build upon.

Not so many years ago, these scenes were the norm. People were exposed to hazards and dangerous situations. Well, we have come a long way, but we still have a long way to go.

Ergonomics, until recently, was a foreign word as far as railroad machinery was concerned. Now ergonomics is a daily concern. We see new machines with ergonomically designed adjustable seats, controls placed in positions to reduce operator fatigue, pressurized cabins with air conditioning to eliminate operator exposure to dust contaminants, ladders, steps, and platforms to allow personal safety, and accessibility to necessary work areas. Manufacturers of roadway equipment have come to realize the response of operator comfort and functionally operating machines. This applies to all levels of equipment from the small walk-behind units to the large complex multi-task machinery.

Servicing of equipment has entered a new era of safety and convenience. While we may have had in the past a tendency to overlook this area as far as safety is concerned, the area of safely servicing machinery has gained ever increasing attention and priority. Making servicing points on equipment easily accessible means reducing operator and mechanics' exposures to slips, trips, and falls. The ease of servicing promotes commitment and assurance that the machine will be properly serviced. If you examine injuries associated with servicing, you will probably discover that with the item being serviced being located in an easily accessible area, the injury may not have happened or it may have been avoided. Original equipment manufacturers also have realized the benefit of properly locating servicing points.

Presently we see equipment with remotely located lubrication points, filters accessible from the ground or platforms with footing that is secure and a person can perform his or her work in a safe manner. You will see steps placed so as to allow access to windows for cleaning or washers installed to promote cleaning. We have, indeed, come a long way but we still have a long way to go.

Operator protection covers a vast area – an area which is all encompassing. Operator protection devices range from the simple to the complex. The importance is not a measure of size or cost. Any device, regardless of the nature, which protects an operator from injury is a major item. Statistics have proven that for every 6,000 injuries, one will be a fatality. Unfortunately, we never know which one of the 6,000 injuries will be the fatal injury. With this premise in mind, railroads and machine manufacturers are consistently designing, working, and reworking devices to safeguard our operators. We have simple stickers, energy control devices, vigil devices such as cameras and mirrors, safety glass, protective guards of all shapes and sizes, and working travel lights. We see flashing strobe lights to help in visually clarifying

machinery in less than optimum weather conditions. Original equipment manufacturers are continually designing and redefining safety appliances. We see machinery equipped with lockout tagout devices to release stored energy.

Manufacturers are developing safer methods to cut brush which we can all agree can cause a need for extensive operator protection. We see the elimination of hazards that not so long ago were regarded as unavoidable. Yes, I believe we all agree that the partnership between rail carriers and equipment manufacturers has grown and developed greatly over the years in the protection of the operators.

Material handling is another area of maintenance-of-way equipment in which great strides have been made. Things that we now take for granted are the result of years of development and this development continues today. Items we see and use such as automatic anchor applicators, spike feeders, ballast regulators, tie handlers, tie inserters, ballast cars with powered unloading doors, cranes of all shapes and sizes, and, let us not forget rail handling equipment. The trends in safety in this area are vast. The opportunities abound. We see more computer-controlled machinery. We see machines to handle tie plates. We are experiencing the beginning of robotics for picking and sorting. We see development of track cleaners at a proportion which we have never seen before. The challenge to both user and manufacturer is great and presents many opportunities for us all.

Operating safety is another area in which we have experienced many improvements. This area to me represents the instructional and training part of the partnership between railroads and manufacturers. This is an area where if something is left out or overlooked an individual can be injured or killed.

Although these areas are difficult to relate to physical safe apparatus, they are very important, if not the most important area of partnership in safety.

Here we see the safety procedures and the necessary training for the safe operations of any item developed. Here we see the lockout and tagout instructions. We see the proper methods of operating. This is the area where videos and CDs have been developed. After all, the creativity and all the development and energy we put into safety design machinery, it's all for nothing if we do not have the proper training and instruction in place for our operators.

I sincerely hope that you have enjoyed this portion of the program as much as I have enjoyed presenting it to you – my view on the continuing trends of safety through the partnership and cooperation of maintenance-of-way manufacturers and today's railroads. Thank you. (Applause) .

Now I will turn it over to Denny. After that, we will entertain any questions that you might have.

Mr. Sullivan: Thank you, John. Ladies and gentlemen, it's my pleasure to be returning to the maintenance-of-way field from the railroad operating field for the first time in about 10 years and back to one of these REMSA shows. It's a pleasure for me to be here and see many of my old friends from the maintenance-of-way side of the business, many of whom I haven't seen in many years.

It's a pleasure for me to speak here today not only on behalf of Plasser American Corporation but on behalf of the maintenance-of-way equipment supply industry on safety innovations and improvements in maintenance-of-way equipment.

The progress that the U.S. railroads have made in improving maintenance-of-way safety equipment and safety in general to me is remarkable. When I think back 10 years, FRA reportable statistics and injuries per 200,000 man hours being in the range of seven to eight. Now you look at statistics in the three to four range, literally cutting the number of reportable injuries in half during that period of time. It's a fantastic tribute I think to the railroad industry that they have been able to move towards improving safety. Indeed, John's railroad who now have ratios down in the one range, is absolutely phenomenal. It's incredible to see numbers like that. It's also very encouraging for the industry.

The maintenance-of-way portion of the railroad have improved safety and have gone a long way towards helping the railroads make those ratios become a reality. Maintenance-of-

way equipment serves the entire railroad industry including freight, inner-city passenger, transit, commuter rail, and high speed rail. I would like to take the opportunity to talk about some of the specific innovations, many of which John touched on in his presentation in maintenance-of-way equipment.

First, ripped strut surfaces. Anyone who has climbed upon a piece of maintenance-of-way equipment, up a ladder or on a jack, particularly with the old diamond plate surfaces that we used to use on equipment on a wet or foggy morning or a rainy day, has certainly experienced at least the sensation of a slip on a surface if not an actual slip and fall. As we all know in the industry, what I call the Big 3, slips, trips, and falls, are the largest category of injuries sustained by the industry. More injuries are reported in that category, I believe, than in any other. The addition of these types of surfaces to steps and platforms on maintenance-of-way equipment have gone a long way towards reducing injuries in this category.

Secondly, entrance and exit protection. Manufacturers have added chains and safety bars to hazardous areas on machinery to block those entrances to prevent entrance by employees.

In this photo you can see the chain across the entrance to the area of an undercutter chain which is a very hazardous area; that being an undercutter in a maintenance operation. These chains and bars serve to remind the employee of the danger associated with entering into such an area and that he or she should take precautions in entering this type of an area. When coupled with operating instructions on how to remove these devices, I think they provide for a dramatic increase in the safety of operation around probably the most hazardous areas in maintenance-of-way operations equipment and they have indeed helped to reduce injuries and probably prevented many fatalities in these types of operations.

The next five protection systems: These systems vary but usually consist of two levels of protection. The first is a heat alarm which served to alert the operator to a heat buildup within the machine and allows the operator or a supervisor or anyone in the vicinity of the machine to take the necessary action to prevent damage to the machine. Or indeed if a fire should start up within a machine, shut the machine down, and fix the problem before it gets out of control. The second level is a monitoring device. On the left-hand side as you look at the photo, you see a system that would be running within the confines of the machine that monitors, usually through an infrared system, the heat buildup within the machine and at around 400 degrees Fahrenheit, these systems usually shut the engine down on the machine. This not only serves to prevent injuries, but to prevent damage and indeed maybe the possible destruction of the machine. These are usually very expensive machines usually so we don't want to see any of them burn up out there on site.

Moving on is the locomotive type headlights. These are standard now on locomotives within the industry and they serve to really brighten up the approach of locomotives. Now, in maintenance-of-way applications, we at Plasser American apply that as standard equipment on machines that operate at 50 miles per hour or above over the track system. Below 50 miles per hour, they use them as requested by the customer in their specifications. They serve to increase visibility during both inclement weather and low light conditions particularly during night operations. Again, this protects both the employees and the traveling public when one of these machines is operating particularly across grade crossings. It serves to alert the traveling public on the highway at the approach of a piece of railroad equipment. We think that has not only improved the safety of employees, but the traveling public as well.

Next is back-up alarms. These are standard on many highway-type vehicles that are used in railroad operations. They have now become almost standard on maintenance-of-way equipment that operates on track. These devices serve to alert employees with an audible alarm of the intention of the operator to make a reverse or back-up move which again has served to save injuries and possibly fatalities on our rail systems.

The use of reflective striping is usually specified by the customer. Here it is on a piece of CN ballast equipment. You can see the striping which provides a visual warning to employees

and again to the public as the units operate over grade crossings. Again, in night operations, the reflective striping gives a warning to highway and to railroad employees that a vehicle is in the area or approaching the area. This is an added safety feature to the maintenance-of-way equipment itself.

We use cameras for reverse moves. Remote-control cameras have been applied on the opposite end from the operating cab of various maintenance-of-way machines to give the operator the visibility that he or she needs to make a reverse move usually at a somewhat slower speed. Here we are operating with a camera, again, with safety because the operator has the ability to see what is behind the machine when making a reverse move.

In that same category, the addition of second cabs on various machines where an operator making a move, particularly in the travel mode, can go to the opposite end of the machine and operate the machine with full visibility and usually at full maximum allowable speed for the equipment to travel back into the clear in a safe manner.

In this photo you can see a cab highlighted on both ends of the bolt machine.

Air horns, which we are all used to operating in a railroad environment, are usually operated from the cab. But now on each corner of many machines a box is located on which a button is mounted, in this case a yellow button, with a horn insignia so that any employee who sees a dangerous situation occurring can press that button and alert the employees of either a threatening activity or even the approach of a train. This puts the safety of the operation directly on the ground and in the control of ground employees.

Emergency shutdown of machines is crucial. Located on the same box as the air horn button is a red button which allows a ground employee again to press it and immediately shut down the machine if he or she sees a situation developing that requires such an action, hopefully a rare event, but they can push one of these buttons mounted on all four corners of the equipment, and shut the machine down immediately. This is another step to improve safety.

Now I want to talk for a minute about three systems which provide not only a safer environment for employees to work, but safer track for maximum authorized speed operations. First, track stabilizers were first introduced in the early 1980s in the United States. They help prevent track buckling which save derailments and provides for safer operation of track. It eliminates or reduces the use of slow orders, and provides for safer, more efficient train operations. While stabilizing track, these machines also retain the geometry by settling the track under control so the surfacing work which has been performed prior to the stabilization is retained. We think this provides for safer and longer-lasting track.

Then we have MDZ units or mechanized maintenance systems. Here you see a MDZ surfacing consist. Machines are coupled together for movement in the travel mode and uncoupled in the work mode. It eliminates the possibility of machines colliding with one another due to a stop at a signal or a stop somewhere in between the work site and the tie-up location as machines travel over the railroad. They are all coupled together and the possibility of collision is completely eliminated. These are common now on surfacing units. We have introduced them on our undercutter operations and we're looking to tie all equipment together in tie-in surfacing operations and loading of the small equipment and the coupling of all the larger types of units in those operations. This, we think, will again enhance safety of the operations on the railroad.

Finally, we have the AGGS system, or the Automatic Geometry Guidance System. It's a computer-controlled system which uses the geometry from the system itself or from another source such as a track geometry car or a gauge restrain measurement system. In our careers, we are all used to the long reference system or what I call the old system where employees had to go out in front of the machines, up and down the track, and set up the buggies and work the system as they were out on the track.

Now we have introduced in the new machines a short reference system where the system itself is contained within the length of the machine. Employees only have to work in the vicinity of the train. The buggies themselves are right under the unit.

These systems also provide real-time data, more accurate data which allows the machinery itself to produce safer track for operations.

Finally, we have a work screen that shows the alignment, cross level and surface, that can be produced by either this machine or the geometry car and fed directly into the tamper for surfacing of track. We have real-time data producing high quality track for safe operations.

What is the bottom line of all this? Less injuries, less fatalities, safer track, safer train operations, and reduced costs.

In conclusion, let me say that in my 33 years of railroading, it never ceases to amaze me that railroad maintenance-of-way equipment departments and suppliers faced with reduced budgets and the requirement to improve safety in shorter work windows, continue to innovate maintenance-of-way equipment to make for a safer and more efficient operation.

Thank you for your attention. With John, I'll be glad to answer any question you might have. (Applause).

Mr. Sensing: I would like to thank both of you gentlemen, and I also have certificates and hats for each of you.

SPECIAL BUSINESS SESSIONS

Merger Vote

President Russell: Number one, I would like to take a moment and thank Dave Hesterman, Randy Poggemiller, Dave Crader, Joe Riley, Ted Haskell, John Rinard, John Blanchfield, and Denny Sullivan for their presentations this morning. They were all excellent and we really do appreciate the time and effort that you gentlemen took to put these things together.

Now comes the highlight of the day so to speak. Each of the three associations here today, the Roadmasters and Maintenance of Way Association of America, the American Railway Bridge and Building Association, and American Railway Engineering Association, will be voting on a merger of three equal partners to form a new organization to be called the American Railway Engineering and Maintenance of Way Association, better known as AREMA.

In order for us to complete a number of procedural formalities, we ask that you hold all comments until the discussion period is announced which will occur after each of the three associations has completed its motions to consider in this matter. We will begin by having each organization open their own special session in alphabetical order.

First will be Joe Lileikis for the American Railway Bridge and Building Association.

President Lileikis: Thank you, Wayne. I would like to call to order a special business session of the American Railway Bridge and Building Association to vote on the proposed merger with Roadmasters and Maintenance of Way Association of America and the American Railway Engineering Association.

I would now like to turn the floor over to Phil Ogden of the American Railway Engineering Association.

President Ogden: Thank you, Joe. I would like to call to order now a special meeting of the American Railway Engineering Association to vote on the proposed merger with the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America. I will now turn the floor back over to Wayne Russell.

President Russell: Thank you, Phil. I would like to call to order a special business session of the Roadmasters and Maintenance of Way Association of America to vote on the proposed merger with the American Railway Bridge and Building Association and the American Railway Engineering Association.

On March 16, 1997, the board of directors of the Roadmasters and Maintenance of Way Association voted unanimously to recommend to its membership the adoption of the merger plan to join with the American Railway Bridge and Building Association and the American Railway Engineering Association to form the new organization. This plan was described in the documents mailed to all eligible voters of the association.

Do I have a motion from a Roadmaster member to adopt this planned merger? The motion has been made by Mr. Dwight Clark. Is there a second? The motion has been seconded by Gordon Basra. At this point, we would like to hold off the discussion of this motion until the other organizations have had the opportunity to make their motions.

President Lileikis: On March 16, 1997, the board of directors of the American Railway Bridge and Building Association voted unanimously to recommend to its membership the adoption of a merger plan to join with the Roadmasters and Maintenance of Way Association and the AREA to form a new organization. This plan was described in documents mailed to all eligible voters of the Association.

Do I have a motion from a B&B member to adopt this planned merger? The motion has been made by Mike Bradley. Is there a second? This motion has been seconded by John Horney. At this point, we would like to hold off discussion of this motion until the AREA has had an opportunity to make their motions.

President Ogden: On March 15, 1997, the board of the American Railway Engineering Association voted unanimously to recommend to its membership the adoption of a merger plan to join with the Bridge and Building Association and the Roadmasters Association to form a new organization. This plan was described in documents mailed to all eligible voters of the association.

Do I have a motion from an AREA member to adopt this planned merger? The motion has been made by Jim Beran. Is there a second? The motion has been seconded by Bruce Willbrant.

At this point, all three organizations have moved and seconded the adoption of the plan of merger. I will now open the floor for discussion for any member of the three Associations. If you have any questions or comments, please identify yourself and with which organization you are affiliated. The floor is now open for discussion.

(Pause)

There being no further questions, please submit your ballots as your leave with the gentleman from Corporate Election Services at the table outside the entry door to this room. You have until 12:30 p.m. to submit them. After that, the election will be closed and the ballots and proxies will be counted. The results will be announced at the start of the conference tomorrow morning.

We appreciate your time and effort. This closes the special meeting for the American Railway Engineering Association. Thank you.

President Lileikis: I would also like to close the special session of the American Railway Bridge and Building Association.

President Russell: As well, the special session of the Roadmasters and Maintenance of Way Association is closed as well as today's business is closed.

Everybody enjoy the exhibits this afternoon and we will resume business tomorrow morning at 8:00 a.m. Thank you very much. (Applause)

(Adjourned)

JOINT SESSION

Tuesday, September 9, 1997

Opening Remarks

President Lileikis: Good morning. The first item we need to address is a safety check. Obviously the exits are the doors in which you entered this room and those are the doors you go back out of. Please don't come over the podium and try to get out these doors. I might get hurt. (Laughter) You all know where the escalators are by now and the first aid center is still on the third floor right by the entrance to the showroom.

For a count on registrants to date, we have a total of 1,991 people registered plus 270 significant others. That puts us currently nine short of Denver. Denver was at 2,000 and we are at 1,991.

At this time I am pleased to announce the results of the election held yesterday to merge the Roadmasters, B&B, and AREA into a new organization along with the C&S division of the AAR, which will be known as the American Railway Engineering and Maintenance-of-Way Association or AREMA. To pass, the merger resolution required a two-thirds majority approval of the eligible votes cast for each of the three organizations. The results of the voting have been certified by Corporate Election Services.

Here are some interesting numbers: The B&B Association voted 300 yes and 19 no. The Roadmasters Association voted 529 yes and 13 no. The AREA voted 1,471 yes and 31 no. With an approval ranging from 94 to 98 percent, the resolution passed and AREMA will therefore begin life on October 1, 1997. Our congratulations to the new members of AREMA on their decision, and my personal thanks to those who worked very hard in putting this together, in particular Mark Walbrun. Mark, would you please stand up? Mark was very instrumental in getting a lot of the legalities taken care of. Thank you, Mark. (Applause)

It is my hope and I am sure the hope of all those that are on the new board that you will give this new organization the same level of support that made each of our organizations successful for over the last 100 years. The future of AREMA is with all of you here in this audience. With the assistance from AREMA, the rail industry can continue to be a prosperous and vital component of our nation's transportation infrastructure and the source of our livelihood, if you will.

That is all I have for this morning, so I am now going to turn the podium over to President Russell.

President Russell: Good morning and welcome to AREMA after the first of October. This morning it's a pleasure and a privilege to introduce Mr. Robert Krebs, chairman and president and chief executive officer of the Burlington Northern Santa Fe Corporation.

Mr. Krebs is a native of Sacramento, California, and began his career in the railway industry when he joined the Southern Pacific in 1966. He was assigned to special duty in the executive department in San Francisco. He subsequently held a number of operating positions throughout the Southern Pacific Transportation Company, the St. Louis Southwestern Railway Company, and became vice president of operations on the SP in 1980. He went on to hold a number of executive positions within the Southern Pacific Transportation Company, The St. Louis Southwestern Railway Company, Santa Fe Southern Pacific Corporation, the AT&SF Railway Company, and the Burlington Northern Santa Fe Corporation of which he was named chairman, president and chief executive officer in April of this year.

Mr. Krebs is a director of Burlington Northern Incorporated, Burlington Northern Santa Fe Corporation, the Burlington Northern and Santa Fe Company, Phelps Dodge Corporation,

Santa Fe Pacific Corporation, and Santa Fe Pacific Pipelines. He is also a member of the board of the AAR, and a member of the board of the Fort Worth Symphony Orchestra Organization, a director of Northwestern Memorial Corporation, and a trustee for Lake Forest College.

Mr. Krebs earned his Bachelor of Arts degree at Stanford University in 1964 where he graduated with distinction and was elected to Phi Beta Kappa. He earned his Masters degree from the Harvard School of Business in 1966.

Would you please welcome Mr. Krebs. Thank you. (Applause)

KEYNOTE ADDRESS

Robert D. Krebs

Chairman, President, and Chief Executive Officer
Burlington Northern Santa Fe

Thank you, Wayne. It's hard for me to believe when you go through that resume that I have been in this industry for 30 years. Sometimes it seems like 30 days and I guess there are sometimes it seems like 300 years. (Laughter) However, it's nice to be here and see some familiar faces. Jerry Murdoch of Southern Pacific and I hi-railed many miles of track together along with Herb Webb of Santa Fe. It's great to be with friends and associates in this industry.

As Joe and Wayne said, these are historic times for our industry. They are historic times for you as members of the Roadmasters and Maintenance and Way Association and American Railway Bridge and Building Association now at the conclusion of the process that you have gone through to merge with the American Railway Engineering Association. I believe you are doing the right thing. There is always some controversy, although it looks like by the landslide vote tallies that there wasn't a lot of controversy. You are doing what you have to do to meet your constituents' — the railroad industry — expectations and needs. It's not unlike what is going on in the American rail industry today in terms of mergers and the size of mergers and the numbers of mergers that we have had. We are doing it for exactly the same reason; that is, to meet the needs of our constituents — the shippers of America who want better service, more reliable service, at better, more economical prices.

That's really what I want to talk to you about today. What is going on in the industry? Why do we have this so-called urge to merge as some people have said? I have to say as an

aside, you get so involved in what goes on every day in the industry that every once in a while it's good to step back and take a look at what is really happening. You need to look at the big picture.

I had a chance to do just that yesterday with a bunch of German bankers in Fort Worth, Texas. They were out of place with their German accents especially when we gave them all cowboy hats and everything. Over the last few years, they actually have been loaning us about $300 million to buy new equipment. So it was my task to explain to them what is happening in the industry and the changes in the industry. So I used the word that many of you have heard to describe our industry and that is "renaissance." We are going through a rebirth or a renaissance and it is truly an amazing thing to think about an industry that is over 150 years old.

During the 1970s, a third of the industry went into bankruptcy. In fact, I can remember when I went to work for Southern Pacific in 1966 one of my roommates in college took me aside and said, "Krebs, don't you understand? The railway industry is dying. It's going bankrupt. If you want to work in transportation, go to work for a good transportation company. Go to work for Pan Am or TWA, but don't go to work in the railroad industry." (Laughter) He was wrong. I think part of the fact that I am here is just luck. But part of it also was a feeling I had back then that our industry had a mission and a life and a role to fulfill for our country that we could do better than anybody else. It has taken decades for us to get to the point where we can prove it, but we are now doing so. I think mergers are playing a big role. In the process we are going about the tasks that many of you perform and that some of you here supply in a way in such a magnitude and degree that we would have to go back to the 18th century to see the construction and the building and the money that we are spending in this industry. So it is truly amazing.

I am going to use Burlington Northern Santa Fe as a good example of why I believe mergers are beneficial and why they have been beneficial to our industry and to our customers. The Burlington Northern, prior to 1995, really was an amalgamation of 330 different railroads that was accomplished over a span of 150 years. Santa Fe had never really had a merger. It was 125 years old. Yet both companies came to the conclusion that they were at the point where they had gone as far as they could go in terms of providing service, and competitive transportation offerings to their customers. I will always believe that the real reason for a merger is customer and marketing driven to provide a better service and better product to the people who count on or who want to count on the entity for their transportation services.

Just ticking off some of the things that were the reasons or the driving factors behind Burlington Northern Santa Fe is first of all, we now have a competitive rail network across the midwestern and western United States. We serve all the ports on the Pacific coast and all the important gateways to the east, from Canada to Mexico. We can provide single-line service to customers. We have one-stop shopping. We have eliminated interchanges, costly delays, and also expensive switching that goes on. We have more direct routes, better service, and more reliable service. We are easier to do business with. That's very important today because our customers have a lot on their minds and they don't want to spend their lives trying to figure out how they are going to transport their goods from one point to another.

Another thing that is important to our company is the diversified traffic base. I have a great example: Grain was lousy for the first half of this year. We had a chance to move some grain to the Pacific Northwest in the first quarter, but we were snowed in. In the second quarter, the world grain markets turned on us and grain dried up. However, intermodal was up 12 percent which carried the day and allowed us to keep our maintenance programs going. This allowed us to keep the cash flow coming to support the long-range objectives of the company. Prior to the merger, that wouldn't have happened. Burlington Northern had 40 percent of its business in coal and grain and we really depended upon bulk commodities. On the other hand, Santa Fe had over 50 percent of its business in intermodal. So when the consumer economy takes a nose dive, then Santa Fe is in trouble.

Now we are a much more diversified company when it comes to our product mix and we are able to withstand economic shifts.

Finally, there is another reason for the merger. Everyone puts this one first, but I don't really believe it is first; that is, the savings we get from being more efficient. This is especially true when it comes to staff areas. Many of you know that because you have been through mergers yourself and you have seen the changes that have taken place in office buildings like at St. Paul and Topeka and Chicago and also Fort Worth. In fact, it wasn't more than 80 days after the merger that we announced reduction of over 1,000 staff jobs as we fought our way through what I call the Noah's Ark syndrome — overnight we had two of everything. We had two presidents, two mechanical departments, two maintenance-of-way departments, two marketing departments, two computer departments, and two finance departments. So we got that behind us as quickly as we could and we moved to our new headquarters in Fort Worth where amazingly enough we had 2,200 people working on our campus right outside of Fort Worth.

That was our first step in getting our merger put together. Once we established that and once we laid the foundation, we turned to the most important task that we have as Burlington Northern Santa Fe and that is safety. I want to comment particularly on safety. I want to talk about how we have done the last couple of years because I believe that is job one for any company and particularly for any railroad. We have not nor will we ever take any action that jeopardizes our number one goal and that is to become an injury and accident-free workplace. We have had some bumps along the road, but we are making the trip and we are having some successes.

Regarding our FRA reportable accidents, if you go back and look prior to the merger in July of 1995, we were running at about 2.7 accidents per 200,000 hours worked. At the end of this July we are down to 1.45. That is a 45-percent reduction on our way to a goal that is 100-percent reduction or zero defects. A way to do a kind of sanity check to see if we are just counting numbers or if we are really making progress is to look at the lost days that our employees have. Over the two-year period, lost days have gone from 47 lost days per 200,000 hours worked down to 29. That's about a 40 percent reduction.

I said we had a few bumps along the road. In February of last year we had two wake-up calls. The first one was a run-away train on Cajon Pass. It was a merchandise train that had received a proper air brake test and even had an emergency application from the headend of the train before it left Barstow. The engineer radioed the dispatcher and said, "I can't stop my train and I am heading down this 2.8 percent grade." By the time that train stopped it was ball of fire and we lost two employees in that accident.

Right on the heels of that, we had another run away train in St. Paul. Fortunately, this did not cause any loss of life or really any serious injury.

Like I said, we still to this day do not know what caused those accidents because in both cases those trains received proper air brake tests and we know the air brakes worked when they left the terminal. But that was, as I say, a wake-up call.

We then pledged to our employees and to the FRA and all the organizations and regulatory bodies that are associated with us that we would begin an era of safer operations at Burlington Northern Santa Fe. Many of you who are our members of the BNSF community know that we brought Dupont on the property and had them go from stem to stem across our railroad observing our operating conditions and our operating practices. We established a 1-800 number so anybody could call in if they had any safety concern because we heard from our unions that our employees, in some cases, felt intimidated and were not able to talk on the property about safety issues. We improved our training and safety for our salaried people. We improved our operating craft training. We doubled the number of audits on our railroad. We went about changing the culture of a 135-year-old company to rely, number one, on everybody's own instincts that safety is job number one and that every accident is preventable and that no accident or injury is acceptable. We have sponsored some of the technology that you, I am sure, have heard about or see at this conference and other conferences where we talk

about maintenance of way and mechanical rail activities and things like positive train separation, a project which we have going on with Union Pacific up in Seattle.

Right now on our railroad we have consists of taconite cars, coal cars, and intermodal cars running with electronic air brakes. We even have a thing we affectionately call a "MOM" out being tested on our railroad. That is a Mobile Operations Monitor. It's a little thing about the size of a quarter, thicker than a quarter, that you stick on your glasses and it watches your eyes. When we are awake, our eyes are always blinking. When we get drowsy, the blinking slows down. When we go to sleep, obviously it stops. So the MOM watches eye movement and when it starts to slow down, it sets off a little alarm to alert the person who is wearing it that he or she is about to fall sleep or could be in a condition where they might miss a signal when they are going by running a train somewhere on the main line. So that is an amazing thing. If it works, it could be used on the highway as well for truck drivers. We'll see, but we are out there testing it and pioneering it. I go out on town hall meetings. As a matter of fact, I have a town hall meeting this afternoon in Fort Worth to explain this to our employees. Sometimes it's hard for them to believe that we don't have it wired into Fort Worth so we know exactly what is going on all the time, but we don't. (Laughter) Hopefully I can convince them of that.

Safety is an ongoing effort for us and it is part and parcel of the fabric of what Burlington Northern Santa Fe is. We do believe — I will say it again — that no accident is acceptable and every accident and injury is preventable.

So, against that framework, what have we accomplished so far in the almost two years that Burlington Northern Santa Fe has been merged? I mentioned the consolidation of staffs and the reduction of the overhead. I mentioned the headquarters that we moved to Fort Worth. I mentioned that we have a new dispatching system now almost fully implemented on the railroad. As of last month, we moved all of our dispatchers into the network operations center in Fort Worth. I was saying before this session started that I don't care how many times you walk into this network operations center, it takes your breath away each and every time. It's like a combination of OMNI Vision and Superdome if you can imagine that. On that floor there are literally hundreds of dispatchers controlling 25,000 miles of railroads real time.

Another big deal for us was the transportation support system which, I believe, is the best. Of course, I am prejudiced, but I believe it's the best computer information system in the rail industry worldwide. In fact, to prove the point we sold the code to the German railway system for $8 million. That was implemented fully on our railroad on July 4th. We pulled the plug on a system that I worked with at Southern Pacific back in 1966 — 30 years ago — the top system. We pulled the plug on the box. It was really based on that system on July 4. So July 4th was independence day for us in more ways than one. This new system now allows us to track every car, trailer, and container. This morning there were 211,000 cars on our railroad. Every car, trailer, and container is tracked against its own individual schedule real time based upon customers' expectations so we can monitor our performance based upon our customers' expectations.

Argentine Yard right here in the Kansas City area was opened on July 7th. We completely rebuilt that yard in 24 months under traffic. We spent right at $100 million on it. We are working the bugs out of that yard as we speak. We are at the point now where we can hump a couple thousand cars a day which is on the way to where we need to be. We are busily tearing down the last old hump at Argentine and putting in receiving and departure tracks. We are doing that around the clock. On October 5th, that yard is going to be done and when that is done, it allows us to change our entire transportation system operating plan because Kansas City is a key for our merchandise switching. When we can consolidate that operation here in Kansas City and Argentine, it frees up Murray to handle coal and grain and take switching out of places like Emporia and Wellington, Kansas, and Amarillo so that we can more economically do the switching and handling of the cars in less time. We will be able to use shorter routes. That will be a big deal for us.

Another really big deal that is important to everybody in this room, not only the members of the Association, but also members of REMSA, is the capital budget that we have. We are now gaining the benefit of things like Stampede Pass. It was a $130 million expenditure to rebuild the whole northern Pacific main line that was mothballed. It had been partially sold off. We needed to have a third main line from the interior of Washington to the Pacific Northwest ports and the business and activities out there. We put that into service in December of last year just in time to have the other two lines washed out or land slided in as a result of the Pacific Northwest storms. That really saved our bacon in the Pacific Northwest.

So there is a lot going on in the way of capital expenditures. I am going to turn to that now and tell you what it is we are doing and what I think we are going to get for it.

One of the benefits of the merger is that this company, Burlington Northern Santa Fe, has the financial strength to spend $2 billion a year in capital expenditures. You go back to the 1980s and the entire rail industry spent about $2 billion. Now, I know a dollar in the 1980s isn't the same as a dollar today, and we have an awful big railroad, and I think that is an incredible achievement. The fact that I have German bankers coming to Fort Worth to loan us the money to support that really tells us something. In fact, we just went out the other day and we issued a $200 million 100-year bond. We got a great interest rate on it which tells us that the way the world views the railroad industry these days is that it's here to stay.

Our board is allowing us to do this with a leap of faith because we still do not earn our cost to capital. We are close. I tell people in the town hall meetings that you have to earn your cost of capital if you are going to take care of your owners. A good example is at a bank you can borrow money at eight percent. If you take it and invest it at seven percent, are you getting ahead? No, I don't think so. That is what the rail industry had been doing for a few years and because of the ability to spend money on capital, we had these vicious cycles that actually led to, I believe, worsening of service, a reduction in traffic, and the bankruptcies that we saw in the 1960s and 1970s.

We reversed that cycle again on a leap of faith that we can earn our cost to capital. We are very close and I believe next year our return on total invested capital in our company, billions of dollars, will be over 10 percent after taxes and we will have accomplished this goal that we have set out to achieve. There is also a philosophy behind spending this money on capital. Those of you who have seen the movie, "Field of Dreams," and have heard me talk before know what I am going to say; that's the famous line in the Field of Dreams, "Build it and they will come." As we add capacity in the industry, we fill it up as fast as it's constructed.

I was in Chicago the other day at another town hall meeting in Willow Springs. There is a $76 million intermodal facility less than three years old and it is full. We are in the process of adding more strip tracks to Willow Springs to take care of the UPSs and Roadways and Yellows and Consolidated Freightways that are coming to us — flocking to the railroad to be our partner and give us more traffic. There's as much traffic as we can handle.

So that's $2 billion three years in a row. We have a big system. We have 43,000 track miles and 14,500 bridges on Burlington Northern Santa Fe. If you line them up in a row, that's 390 miles of bridges. There are 88 tunnels which equates to 35 miles worth of tunnels. Just normalized maintenance on our system a year costs us three quarters of a billion dollars. That's 750 miles of new rail, 130 miles of secondhand rail, three million wood ties, 150,000 concrete ties, 4 miles of bridges rebuilt, 175 miles of pole line taken down, 500 to 700 miles of microwave replaced, 900 new vehicles on our system just to keep us even, 300 roadway machines, and 1,500 roadway crossings refurbished every year. That's three quarters of a billion dollars. Over and above that, we are spending another half a billion dollars to add capacity and improve efficiency and to make this railroad in our industry stronger to support our country's transportation requirements.

I was the chairman of the National Commission on Intermodal Transportation a couple years ago and one of the things I learned is the infrastructure deficit our country has is

tremendous and it's growing. We were talking about trillions of dollars. Here we have a private company not taking government funds, paying taxes while we do it, putting $2 billion back into the transportation infrastructure of America. I do believe we have a mission to fulfill and I believe we can do that at the same time that we take care of our customers, our employees, our owners, and the communities that we serve.

I mentioned a couple of the projects. The big projects that we are spending money on now or have just completed or almost completed is Argentine Yard at $100 million, and Stampede Pass at $130 million. I was telling Herb Webb that we are double tracking the former Santa Fe main line through Texas and New Mexico as fast as we can. We are triple tracking the Powder River Basin. I went out the other day and looked at the area between Gillette and Alliance, Nebraska. On our main line through the coal fields we really have just barely finished double tracking and next year we are going to start triple tracking that. That is about a $40 million project. So we are spending half a billion dollars a year on maintenance of way capital improvement projects and then there is a lot of money that is going towards both locomotives and cars, but primarily locomotives. We are building over 500 locomotives a year. In the three years since BNSF has merged, 1996, 1997, and 1998, we will acquire over 850 brand new locomotives at an expense of over $1.3 billion. Again, it's based on the philosophy to build it, provide the capacity, and the customers will be there.

So it is an absolutely impressive undertaking what we are going through today. It all goes back to the vision of our company which I believe could be and probably is in many different words and expressed different ways, the vision of our industry. I will say it for Burlington Northern Santa Fe; that is, we will realize the tremendous potential of Burlington Northern and Santa Fe by providing transportation services that consistently meet our customers' expectations.

That is what you have to do with your new Association. You have to meet the expectations of your customers who are members of the railroad industry.

When we set up the vision for Burlington Northern Santa Fe, we didn't stop there. We said, how are we going to know? We have four important constituencies to which we relate. I already mentioned them to you: They are our customers, our employees, our owners, and the communities we serve. We said if I am a customer at Burlington Northern Santa Fe, how will I know if Burlington Northern Santa Fe is fulfilling its vision? It's very simple. Easy to do business with, 100 percent on time, damage free, accurate and timely information, and the best value for the transportation dollar.

I will just pause there for a minute on the best value for the transportation dollar because as we succeed in our industry, it isn't going to be by raising rates and taking us to prosperity, because ever since deregulation, rates have dropped. They are now 50 percent in real terms of what they were prior to deregulation. Every time a big contract comes up for bid, we are talking about rates going down, not rates going up. So our customers expect the best value for the transportation dollar and we are going to continue to see that pressure in the years ahead. I don't think the merger scene has changed that a bit. Because what we will have is fewer competitors, but stronger competitors. That is what the industry is working its way through right now. My prediction is the result will be a better transportation service at a better value for our customers.

A lot of the work and the activity that is going on that I have just described at Burlington Northern Santa Fe is also going on throughout the industry and falls on your shoulders. We are talking about construction and maintenance, because you have to provide the skill, the knowledge, and the leadership for these projects to move forward so that we can benefit from them. I believe you should be confident in the future of the industry and also proud of the part that you are playing in the role that we have been creating with this renaissance. Again, it has not been since the days of the Holidays, the Harrimans, the Hills, the Stanfords, the Crockers, or the Huntingtons that we have seen activity in construction of the magnitude that we have going on in the industry today.

So, just as rail companies in your industry have merged, now you are following suit. You have had your vote. Your organizations have brought to this historic meeting over a century of history. Our industry has been well served by the engineering and maintenance professions and I have no doubt that we will continue to be well served by you in the future and that the new American Railway Engineering and Maintenance-of-Way Association will play a significant role in the progress of the industry.

I wish you a successful conclusion to your convention here in Kansas City and, again, I hope that you all leave with a sense of appreciation for the accomplishments of this industry over the last 150 years and a sense of pride and anticipation of the role that you will play as we continue our progress over the next 150 years. Thank you. (Applause)

President Russell: Thank you for a fantastic presentation. We really appreciate your taking the time out of your schedule to come and address us. As always, here is a token of our appreciation. This is a historical cap because the Associations cease to exist any longer. But ladies and gentlemen, Mr. Krebs has agreed to field any questions that you may have. I would appreciate it if we could get some participation here because it's a once-in-a-lifetime chance to get him to sit down long enough to answer some questions.

So I am going to lead off with one that I am sure you get quite often. As the industry continues to change and, of course, we have seen things happen on the eastern side of the United States with CSX, Conrail, and Norfolk Southern, what do you predict over the next two or three years in regards to mergers?

Mr. Krebs: I talked about the benefits of mergers in terms of one-stop shopping and single-line service and I believe they are alive and well. It's clear to me the larger the merger the more difficult it is to gain those benefits because of the period of time you go through as you put everything together and get a new organization in place with new computer system, for example, which is probably the biggest problem that we have had at BNSF. It just takes time.

There is no doubt in my mind that we will show our customers over time that they get a better transportation product and their lives are made easier by systems that have wider geographical coverage.

Now Burlington Northern Santa Fe does pretty well in the west with 28 states and a couple of Canadian provinces. We are working with a map that doesn't look a whole lot different than the interstate highway system. So if that's true, and if I am proven correct in the future, then you could say the same thing about a system that goes all the way from the Atlantic to the Pacific Ocean because we have the interstate highway which does just that. I do think some day the marketing forces will drive us to transcontinental mergers. Now, I think it's going to be a while. Originally I thought maybe we would even be talking about one right now. I think you mentioned the Conrail and CSX and Norfolk Southern situation in the east. That is going to take a while. That is not going to be easy. The government has a 350-day schedule, I believe, to hear that merger and to decide on whether or not it will be approved. I think it will. I think it creates competition in the Northeast that we haven't seen since the days of the New York Central and the Pennsylvania. I think it's good for customers. I think the way they have decided to split it up is procompetitive.

So I think that's the right step to take. But then that has to get digested. At the same time BNSF and UP have to get our act together. So my guess is it's going to be a while. In the meantime, that's fine with me because we have plenty to do at Burlington Northern Santa Fe.

President Russell: Anyone else?

Member: As far as this audience is concerned, a lot of people here are from regionals and shortlines. They seem to be a pivotal part of this transition that is being made in the renaissance. Could you comment on where they fit in?

Mr. Krebs: That is a really good point and I think you are right on. We want to be a partner with shortlines. Back in the old days when we looked at selling off a piece of rail track or railroad, what we were looking at is getting some money up front and escaping. It's not what

we are looking for at all anymore. What we are looking for is a partner. We are looking for someone who can go out and provide better service than we have, do a better job than we have done in the local area, and promote rail business from which we can both benefit. So we want to be partners. I don't want to say this the wrong way, but we would like shortlines, in essence, to be part of our family, to be an extension of Burlington Northern Santa Fe to make available things like our computer program to help promote seamless transportation, and to help shortlines produce a better product which is part of an overall product in helping the customer go from point A to point B on our combined railway system.

Mr. Lewis: Mr. Krebs, I am Phil Lewis. I am with a contract service providing services to the rail industry. There has been an awful lot of outsourcing particularly on Burlington Northern and all the railroads and those of us in the supply business are benefiting from that. Could you address the policy of how that is going to go in the future of your outsourcing of a lot of the support processes that you use to run the railroad?

Mr. Krebs: Sure, I would be happy to address that. I will tell you exactly the same thing I told 8,000 employees face to face in probably 55 town hall meetings over the last year and a half. I mentioned that there are four important constituencies when it comes to the Burlington Northern Santa Fe. One of them is our employees. My goal is to provide a stable work environment for employees. When we hire an employee, I would like that employee if he or she wants to do it, to be able to retire from the company 30 or 40 years later.

So, I feel an obligation to all Burlington Northern Santa Fe people to use them to do the tasks at hand. I also understand that we need to be competitive and that we have incredible programs that come and go at various parts or geographical locations on the railroad like Stampede Pass, for instance. It makes sense for us sometimes to use contractors and that oftentimes because of institutional baggage in the industry like the Railway Labor Act, the Railroad Retirement System, and Federal Employers Liability Act, that the contractors can do a better, quicker, more efficient job for us.

So, I tell the employees right out. We will take a look when we have these tasks that need to be performed. Contracting out work is not our first choice. We are not going to do it at the expense of somebody who works for Burlington Northern Santa Fe. However, wherever we can use contractors and it makes sense, we are going to do it and that's a fact of life.

Member: I understand all the energy that goes into making mergers work, but I believe I am still hearing words from the railroads that service reliability is still in the neighborhood of 65 or 75 percent on average. I know that certain services must run much better than that. However, to make the thing really grow in the future, doesn't that eventually have to improve if that is a fact?

Mr. Krebs: You bet your sweet life. That goes right back to one of evidences of success. We must be 100 percent on time, damage free. Burlington Northern Santa Fe is a big railroad. The one I worked for before in 1990 when we put in our computer system it let us measure real time dock-to-dock transportation performance and service performance. At that time, we were 65 percent on time dock to dock. There's a saying on the classroom wall in this child's school that the truth will set you free, but first it will make you miserable. I can tell you we were plenty miserable. We were 65 percent on time dock to dock.

At the time of the merger in 1995, the full year 1995, we were 92 percent on time dock to dock and in our intermodal area where we are competing with trucks there is no reasonable trucker at any less than 97 or 98 percent on time. We were right up there with him.

So here we go again. We have a new computer system just installed. We have new operations. So where are we now? We are in the 80 percent range. We will get to the 92 percent range and go beyond it. We can do it. We will do it with a better product mix and we will do it in a way that is easier for our customers to do business with us. That's why we are spending $2 billion a year. Because you have to have locomotives to do it. You have to have tracks. You have to have yards to switch cars. You can't run 92 trains a day across a single track piece of

railroad like we have done on some days out in New Mexico and Texas. You can't run a coal train going 15 miles an hour up a two percent grade at Crawford Hill the same time you are trying to run an intermodal train at 40 miles per hour. That's why we are spending the money. Build it and they will come. Provide the transportation service and provide the reliability and we will get the business.

I really believe that we will do that. We have shown moments of excellence. The largest customer on our railroad is UPS. In the two peak seasons we have had, Thanksgiving to Christmas Eve, they shipped each year over 27,000 trailers on Burlington Northern Santa Fe from Thanksgiving to Christmas Eve. During the first year we had exactly zero failures. Every trailer got to its destination on time to be sorted. Packages were delivered to the customers expecting them for the holiday season. Last year we didn't do as well. We had 11 failures out of 27,000 trailers because of weather in the Pacific Northwest. It shows what we are capable of. It shows what we have to do for everybody if we are really going to fulfill the vision and realize the potential of our company. It's a good point.

President Russell: Thank you very much, Mr. Krebs. (Applause)

I am now going to turn the podium over to Reuven Shiloh.

Mr. Shiloh: Thank you, Wayne. Our next feature is Operator Training and Competency Certification. It will be given by Bill Roe, director of safety, Union Pacific, and Gerry Woods, GRW Contracting and Consulting.

Bill began his work on the former Missouri Pacific railroad as a trackman. Upon graduating from Southwest Missouri State University with a Bachelor of Science degree in mathematics, Bill continued his employment with Missouri Pacific as a management trainee, track supervisor, and roadmaster. In 1986, Bill moved to technical training, first as an instructor and later as manager engineering services training. In 1990, Bill led the development of the Union Pacific's machine operator training program and is now reaping some benefits of the training program as director of safety.

Bill will talk about machine operator training and competency certificate.

OPERATOR TRAINING AND COMPETENCY CERTIFICATION

Bill Roe

Director Safety
Union Pacific

Gerry Woods

President
GRW Contracting & Consulting

Mr. Roe: Good morning. I want to thank you for allowing me to present our committee's report on operator training and competency certification.

I would also like to introduce Gerry Woods, formerly of Conrail, and now president of GRW Contracting & Consulting. Gerry, and the other committee members, lent their expertise and experience in the preparation of this report. Gerry also invoked his seniority and overall experience and allowed me to make this presentation, but he is ably by my side in case I should go down. (Laughter)

In the process of preparing this report, we talked to several of you about your specific training qualification processes. It is nice to be able to borrow or steal, depending on your perspective, a few good ideas and do it all in the name of this fine organization.

In these days of tight budgets, increasing traffic, heavier axle loads, and shorter track windows, it is more important than ever to get the most out of our equipment. We continue to raise the bar in the areas of safety, quality, and production and rightfully so. We continue to expect more out of our equipment suppliers. We not only demand safe, fast, and reliable machines, but also service to match.

We continue to search for new ways to mechanize what hand labor is left and to improve our work processes to take advantage of the time that we do get on the track.

One key to making all these efforts pay off is to have machine operators who can safely and efficiently get the work done. How well we train and qualify our operators plays a big part in preventing injuries, minimizing the amount of rework, accomplishing our production and maintenance goals, and from a purely business perspective, making good on our huge investment in this equipment.

This committee's charge and therefore the objective of this presentation is twofold: First, to familiarize you with the current state of machine-operator training and qualification among railroads and railroad contractors. Second, to familiarize you with the components of a good operator training program and a good operator qualification process. We not only want to tell you what is out there, but also give you some direction in designing, or redesigning as it may be, your own programs.

In order to find out what the current state of operator training and qualification is among railroads and our contractors, we did surveys. We did some in written form and some by telephone and some face-to-face interviews with some of you here. We didn't try to include every road in the survey, but instead we focused on trying to get a good cross section of railroads including Class Is, regionals, shortlines and commuters. We also surveyed a few railroad contractors and suppliers.

The respondents answered a number of questions related to their current training and qualification processes. I won't cover all the questions and their responses, but I would rather like to focus on a few of the more critical issues.

One thing that nearly everyone agreed on was the attributes of a good machine operator. Among the most popular responses were first and foremost a good attitude. I think everyone in this room has at some time or another hired or promoted someone based solely on his or her attitude towards the job. Respondents to our survey said that they would prefer to have an operator with a good attitude than any other single attribute. They also told us what a good attitude consists of: being safety conscious, willing to learn, being responsible, and using good judgment.

We also want somebody who has good motor skills, particularly good hand-eye coordination. We want somebody who may have had past experience running similar equipment. Finally the survey said we wanted someone who possessed good mechanical skills, and someone who has the ability to maintain, service, and troubleshoot mechanical problems. As we all know, our work equipment mechanics are spread pretty thin especially during the production season.

We asked what type of training each respondent currently had in place. Every respondent said they had some form of operator training in place although 27 percent relied strictly on OJT or on-the-job training. Nearly 75 percent of those surveyed have some type of formal training program in place. Nearly all of this 75 percent also offered some type of refresher training. Most of the respondents said that their on-the-job training consists of putting an experienced operator with the new man for at least a few days until he got the hang of it.

Many times when we think of OJT we think of putting someone out there on his own without any help of any kind. The respondents in this survey used the term OJT to mean that we would put an experienced operator with the trainee until he felt comfortable.

I believe that as long as you incorporate the basics into your training, whether it's formal, structured training, or whether it's on-the-job training, it can be effective. I will talk about the basics in just a few minutes.

All the respondents said that both current operators as well as operator candidates were required to attend their training. A full 64 percent said that they require employees to attend training prior to operating the specific machine. We found that 27 percent also required supervisors and mechanics to attend formal training as well. When we set up our machine operator training program on the Union Pacific seven years ago, we made a special point to include training for the surfacing gang foremen and I am glad we did. We have main section foremen or extra gang foremen who end up on tamping gangs without much of an idea how the tampers work and what their specific responsibilities are. I think this training has helped in this regard.

We also asked our respondents who conducted their training. The respondents said that on average, 80 percent of their training was done in house by their own employees. Some also have dedicated trainers, some used experienced operators or equipment supervisors on an as-needed basis to conduct this training. The equipment suppliers were responsible for most of the other 20 percent with a few roads using a third party, primarily another railroad or an outside training source. Everybody said that they had some form of testing whether it was performance-based testing which is really nothing more than requiring the operators to demonstrate their proficiency in actually operating the machines or whether it was a written test to demonstrate the knowledge or both. Ideally, you want both as 73 percent of the respondents do have. You want someone who can demonstrate skills, but I believe you also want someone who can demonstrate knowledge of rules, operating procedures, and someone who can understand the operator's manual and other written forms of communication. We found 27 percent required only performance testing during their training. While most roads require their operators to pass a rules test, a few did not. Obviously all operators must be trained and qualified on the new Roadway Worker Protection Regulations on an annual basis.

On the qualifications issue, we asked what time period the operators had to qualify in. The majority of roads, 64 percent, afford their employees 30 days in which to qualify. For those roads that are part of the National Agreement, this actually becomes a disqualification period rather than a qualification period because, in essence, if the operator is not disqualified in this period, he automatically becomes qualified. This doesn't prevent a railroad from disqualifying an operator at a later point for unsafe practices or rules violations, but it does make it a little more difficult. We found that 36 percent either didn't have a definite qualification period or it differed for various machines.

We asked the respondents who qualified the operators. We learned that 45 percent said that only the immediate supervisor or equipment supervisor or both could qualify an operator. Also, 55 percent said that others, in addition to the supervisor and equipment supervisor, could also qualify their operators. Specifically mentioned were other operators, mechanics, and dedicated trainers.

Finally, we asked the respondents how satisfied they were with the training programs, qualification processes, and the overall quality of the operators. On a scale of one to ten with ten being the best, the responses were as follows: For the level of satisfaction with their own training program, the responses ranged from three to nine and averaged right at six. Even among those who rated their training programs fairly high, there was a call for more training.

For the level of satisfaction with their own qualification process, the responses ranged from four to eight with the average being 6.7. The respondents were generally happy with the quality of their current operators rating them at 7.4 again on a scale of one to ten. What I take from that is that even though some people feel their training qualification programs could use a face lift, the supervisors are fairly satisfied that they are getting the right people and that those people are performing well. The question then becomes how much pain, frustration, and lost opportunity did we endure to get our current crop of operators up to speed? For some it seems it's a constant battle. For others, their processes seem to work well.

So that's where things stand currently, but I would feel we were only giving you part of

the overall picture if we didn't talk about what a good training program and a good qualification program should look like. The survey was the objective part of this presentation, and this is the subjective part.

We feel that any good machine operator training program should consist of at least these five components: The first is clearly defined learning objectives, then hands-on training, reference materials, testing, and follow-up evaluation.

First, we will cover a clearly defined set of learning objectives. Simply put, these are what the operator should be able to do after he or she has completed the training. You can call them goals, targets or whatever you like, but they are the foundation upon which the training is built. If you don't have clearly defined objectives, your training tends to meander all over the place. Defining these learning objectives early on even with on-the-job training allows you to focus on the critical skills. These learning objectives should be very specific and it should be skill based.

Here are some examples of good learning objectives for a few different types of operator training. I always like to frame the learning objectives with the part that is in the italics. After completing the training, the employee will be able to:

- Set up the laser buggy for tamping operations on tangent track.
- Transpose ballast from one side of the track to the other.
- Perform a proper pre-work inspection of the machine.
- Secure the machine for tie up.
- Tie down a machine for travel on rail cars.
- Change a set of rail clamps, broom hoses, and wire rope depending on the type of machine.
- Using the crane's load charts to determine whether a proper lift can be made at the given radius.
- Reeve a multi-part block and properly rig loads.

Obviously the above pertains to various types of equipment.

These are all skills which basically answer the question, what will the operator be able to do, not just know, but do, after completing the training. I mentioned earlier that even on-the-job training can be effective if we have the basics and defining these learning objectives is the most basic element in designing any training.

Also make sure that the learning objectives are comprehensive; that is, make sure they cover the basic requirements of the job. If you don't train a tamper operator how to change a set of rail clamps, it's pretty hard to disqualify him later for not doing it right or taking too long to do it. One way to make sure that you have covered the basics is to bring in a few good machine operators and have them go step by step through their job tasks. This type of job analysis is very helpful in the design and development of any training program.

Second, operator training should include hands-on training. This is an absolute must for beginners. There is no way that you can sit in a classroom and learn how to run a locomotive crane. You can learn about the crane, you can learn how to read a load chart, you can even learn basic reading principles, but you won't learn how to run the crane until you sit in the seat and pull the levers.

For advanced training with experienced operators who already have the basic skills, hands-on training is still preferred, but it may not be required in all cases. Make sure that you conduct the training on either identical equipment or very similar equipment. When you conduct the hands-on portion of the training, make sure that you create a learning atmosphere. Don't get caught up in trying to train a new operator in the middle of a high production gang. If possible, do the training on the yard or industry track away from the other distractions such as passing trains, workers working around the machine on the ground, and keeping up with the gang. Make sure that you can concentrate on the training.

Also the trainer should demonstrate each operation before requiring the trainee to perform. Show him how to do it and then let him do it. I would suggest that you limit the number of students to no more than eight trainees per instructor when you are conducting hands-on training. Depending on the type of machines, sometimes the student/teacher ratio of three or four to one is more realistic. Some roads even dedicate one qualified operator per trainee and that's great.

Since getting the right equipment dedicated for training purposes can be sometimes next to impossible, some roads have even come up with pretty good alternatives to actually operating the equipment. At least one road uses a crane simulator to train its crane operators. A couple of other roads use interactive video instruction prior to the hands-on portion of the training.

A good training program should also include good reference materials particularly for operators running complex equipment. Even good operators who have completed well-designed training won't remember everything from the training and many of the operators manuals aren't very user friendly. The reference materials should only include essential information, such as what has to be done prior to traveling the machine, and they should be in an easy-to-read format.

Obviously, from my presentation you can see that I like to use bullet points. However, there are several other ways to format the information such as flow charts, step-by-step procedures, and information mapping. The bottom line is that any operator should be able to understand what you want them to understand. Some suppliers have done a really good job in providing warning notes complete with illustrations or diagrams to reinforce especially the important safety procedures.

When you create reference materials, make sure to keep them brief — a few pages at most. Remember we are not trying to create another Operators Manual. A good training program should include testing the learner against these learning objectives. Some people make the mistake of training on one thing and then testing on another. One thing that you realize pretty quickly when you begin your training development is that you can't possibly train and test over everything. Select those skills which are basic and critical to the success of the beginner operator including those things related to safety and stick to them.

As I mentioned earlier, requiring the operator to demonstrate those predetermined skills is a much better measure of proficiency than are written tests. Use task weighting to ensure that the measures you have in place reflect the relative importance of each particular skill to the overall job.

Follow-up evaluation by the supervisor is important for two reasons: First, to ensure that the operator is practicing the skills learned in the training; and second, to evaluate the training itself. From a training perspective, the best feedback that you get comes not from the students themselves, but from the supervisors to whom they go back. Supervisors should offer feedback on each trainee to those doing the training. If at all possible, this evaluation should coincide with the qualification process using the same set of criteria used in the training. Another thing to keep in mind is that you must allow the operator to use his skills when he goes back to the job. If we are trying to train an employee to be a back-up tamper operator, obviously we need to let him practice his skills on a regular basis after he completes the training. This is especially important for complex equipment.

A good qualification process must include three things:

- Specific measures of the operator's skills.
- Testing against those measures.
- Proper documentation.

First, at the very least, the qualification process should contain a check list of tasks that the operator should be able to perform. This list will probably go beyond the learning objectives set out in the initial basic training because, as we said before, the learning objectives should focus primarily on the critical skills. These tasks will normally fall into one of three categories as follows:

- Safety, such as requiring the operator to maintain the proper equipment spacing when working or traveling or performing a proper pre-work inspection at his machine.
- Quality, such as monitoring for proper curve elevation or for the proper spiking pattern.
- Productivity such as the number of feet surfaced or the number of ties installed.

After you have developed the checklist of the tasks, then you must take the time to have the operator demonstrate his skills in performing those tasks. We need to get away from taking the attitude that if an operator doesn't hurt himself, hurt someone else, or tear up the machine within the qualification period, then he should be qualified. Ideally this testing should be part of the training process. We should be very methodical and use a formalized process to qualify operators. This type of process promotes consistency and fairness, but can't always guarantee them.

The other issue that is important during the qualification process is to have an experienced person actually do the qualifying. They don't necessarily have to be a qualified operator, although that would be best, but they at least must have a good working knowledge of the operation of the machine. If it's a crane, you must be familiar with the load chart, use of outriggers, proper rigging, boom inspections, and that type of thing. If it's a tamper, you have to know how to put in proper superelevation to make alignment changes, and surface switches, and that type of thing.

Proper documentation of this whole process is becoming increasingly more important because of the regulatory scrutiny primarily in the form of Roadway Worker Protection Regulations and challenges by the employees and their organizations. There are a couple of roads that have taken the time and energy to put together very detailed qualification procedures that are excellent. Besides promoting consistency and fairness in the process, proper documentation also provides feedback to the operator of his progress. In fact, one road uses this qualification process not just to initially qualify an operator, but to keep track of his progress on an annual basis. This documentation can also help down the road to mitigate the railroads liability if, God forbid, that operator is involved in a personal injury lawsuit.

Before I close, I would like to talk just for a couple of minutes about our collective challenges in regard to operator training. The first challenge we see is to expand our relationship with our suppliers to ensure that we get a well-designed training program for every machine that we buy. Our suppliers have proven over the years that they are more than happy to help us design training that will meet our needs if we work with them.

Yesterday I listened to the roundtable discussion led by Phil Ogden on the future of roadway equipment development. During that discussion, the issue of standardization of equipment was kicked around quite a bit. To a much lesser degree, the same issues apply to operator training; that is, although you can't take a one-size-fits-all approach to training, you can develop a basic operator training program that each railroad could then take and customize as they like. In my opinion, the roadmasters training committee is in a terrific position to lead this process.

Second, each road has to figure out how to allocate the necessary resources to train our operators given limited budgets, equipment, and track time. Not every road takes the same approach to training because every road has different needs and requirements. What works well for one road may not work at all for another. The point is that every railroad or railroad contractor, even those with limited financial resources, can design a training and qualification program that works for them.

Finally, we need to work with our labor organization to solve the problem of spending the time, effort, and money to train an operator only to have that operator bid off to another

machine which, in turn, requires additional training. Even if you are doing only on-the-job training with the operator, this situation multiplied over and over again eats up a great deal of time, effort, and money. When I managed the training department, there were more than a few employees that I saw time and time again in different training classes. I am not in any way suggesting that we should not fulfill our training commitments to our employees, but rather I am saying that we need to work with our organizations to ensure that we derive the benefits from this training that we should. This is more of a problem, I believe, with the bigger roads that have large seniority districts and has to be resolved through labor organizations.

Thank you for the opportunity to share with you what we learned on the state of operator training and also to share with you our suggestions on designing or redesigning your training and qualification programs. Again, I urge you as members of this professional organization to take advantage of the expertise and experience of the members of the Roadmasters Training Committee. That is the committee's report.

In closing, I would like to share a couple of thoughts from my experiences with operator training. As I mentioned earlier, we began a formal machine operator training program on the Union Pacific seven years ago. We began by bringing together some of our best operators to help us in the design and development of that program. We promoted four of our best operators who possessed good communication and people skills to actually conduct the training.

Has this training been successful? I think so. However, the better measure of whether or not it has been successful lies in the fact that the supervisors are continually asking for more training knowing full well that they will lose the productivity of that employee for the duration of the training. The success of the training is also borne out in the reduction of personal injuries for not only the machine operators, but for those working around the machines. Do we still have personal injuries related to operator error? Sure we do. However, they are becoming fewer and fewer. Does our approach make sense for every other road? Maybe not, but that shouldn't stop anyone from developing a program that does make sense for their operation.

Now I would like to thank Gerry for all his help in putting this report together and thank you for your attention. (Applause)

Mr. Shiloh: Thank you very much for that informative presentation.

Our next speaker is one of the greatest woman athletes of our time. I had the chance to meet Diana Nyad outside a few minutes ago and I am already anxious to hear her speak.

Diana Nyad made the front page of every newspaper in western world in 1979 when she broke the world record for the longest swim in history. That amazing non-stop 102 mile record still stands to date. Over a ten-year period, Diana set many world records including circling Manhattan island and crossing Lake Ontario. She was inducted into the International Women's Sports Hall of Fame.

Diana is equally impressive out of the water. She was an announcer for ten years with ABC Wide World of Sports covering three Olympic games. She has hosted the U.S. Open Tennis Championships, has her own commentary on national public radio and has written two books. Diana is also one of the most inspiring public speakers in the country.

Let's give a warm welcome to Diana Nyad. (Applause)

THE COURAGE TO SUCCEED

Diana Nyad

Journalist and Former Marathon Swimmer

I have never heard my name pronounced in such a sexy way. Thank you.

Good morning. I do a lot of public speaking and I often say to my boyfriend, "Come on. Come with me. We'll have a couple days of fun." No matter where I am going, he listens to who the group is and then says, "You go ahead. You go on your own. I'll see you when you get home." But then I was on the speaker phone the other day and I said to the woman who was organizing this event, "What is the group like? What do they do?" Then another question I came around to was, "What is the ratio of men to women?" She said, "Oh, that's probably about 99 to 1 men to women." My boyfriend said, "I'm coming." (Laughter)

Many of the groups I speak to are very uptight corporate groups. They really live by the corporate credo that what you wear is very important. They call me months ahead of time before the talk and want to make sure that what I am going to wear is very appropriate for the group. They want to know what kind of language I'm going to use because they don't want any obscene language whatsoever. Sometimes you even have to sign a little letter saying you will never use any obscene language in the group. So this is my quick way of thanking you very much because, number one, looking around the room this is probably the first time I have ever been the best dressed person in the room. (Laughter) So I thank you for that. Also at the hotel last night I watched the second half of the Kansas City game with a bunch of you guys. It really makes me very comfortable to know that I am with a group that not only doesn't mind, but pretty much prefers obscene language. (Laughter)

Anyway, as you know, I got involved in this nutty, eccentric sport of marathon swimming. What does that have to do with your world and what you do? It doesn't have anything, but the real truth is life is life, isn't it? It doesn't matter where you work or what you do. In the end, we are all just trying to do the best we can with our days, our communities, and our families. The truth really is that I would love to sit down in a chair here and have every one of you come up and take about a half an hour like I am going to do to tell the story of your life and what you have learned so far.

People read these quotes by Winston Churchill and all those quotes have nothing to do with what we do. It's what you learn from your grandfather, from your uncles, and from the people in your life who really gave you the wisdom to get through the tough stuff. I would love to hear all of your stories because we are all living the same life.

So I have a life story that involves this eccentric sport, but it's really what I extrapolated from that. I am not in that sport anymore and I am still living by the same philosophies, the same ethics, and living with the same passion.

So I want to tell you a story, but I don't want you to feel like it's a swimming story. It's not; it's a life story.

I grew up down in Fort Lauderdale, Florida, and I had this Greek Egyptian father. When I was a real little kid just beginning to get a sense of identity of who I was and what my dreams might be and who I might be in the world, he said, "I want to show you something." He took out the dictionary and turned it to the letter N and turned it to the word "Nyad." My name! I knew how to spell my name at that point and I looked in there and there it was in black in white in the dictionary — the definition of oneself. Well, he read out what the definition was. Definition number one was in Greek mythology the Nyads were the little nymphs that used to swim to protect the Gods in the fountains and the lakes and rivers. They were the female swimmers in Greek mythology. Definition number two was more modern. The Nyad was a

champion swimmer. Well, all I fixated on at age five or six was the word "champion." My father very much believed in destiny. Now your name is in the dictionary and this is what you are going to be.

Sure enough, by the age of ten, I had met a coach who happened to be an ex-Olympic swimmer from the Melbourne Games in 1956. He was an ex-all-American football player from the University of North Carolina. He was pure fire. He was the most charismatic character and role model I had ever met. He said I was going to be the best swimmer in the world. I believed him.

By the age of ten, I was so serious that I was swimming six hours a day. You know yourselves, you have kids, and you remember when you were a kid that you don't talk a ten-year-old girl or boy into doing anything for six hours a day. You do it because you have the fire for it yourself. I got up at 4:30 in the morning every day, Christmas included. My eyes were red and swollen. They didn't even have goggles in those days. The chlorine exposure was tremendous. I had a thirst and a vision that I was going to stand on the Olympic platform and bow my head and receive a gold medal and be the best swimmer in the world.

I remember when I was 12 that same Greek Egyptian father who had told me about destiny and, sure enough, when I had started swimming, he said, "You see." Well, he called me into the bedroom when I was about 12 so I was two years into this serious, dedicated routine. He spoke to me with a very thick accent. He paced around with his arms around his back and he said, "You know, your mother and I are very worried about you. You don't go to church anymore on Sundays. You are getting up at 4:30 in the morning, every morning. Your eyes so swollen your mother has to pack your eyes in ice at night. You don't eat dinner at home anymore. We don't know what to tell our friends where you are. We think you are a fanatic." I got up and I said, "That's right, Dad. You know why? Because this kid is going to Mexico City to the Olympic games and until I get there, this is exactly how I am going to live." He said, "I know, I know. I tell you, your mother and I, we figured it out. You are a fanatic. I just called you in to give you the key to the house because we can't live like this anymore. Good luck." (Laughter)

So my parents in their way didn't understand, but they were very supportive. They let me on a very long leash and just said, "Good luck."

A couple of years went by and I got better and better. You know how it is if you are good at something; you get a little pat on the back and you get some support from your peer group. Then you want to become even more dedicated. It came to be that when I was 16 years old I won the United States Nationals. I was the best in the United States. Later that summer, I broke the world record for the 100-meter back stroke. I was the best in the world! I wasn't a skinny ten-year-old girl anymore saying, "That's right, Dad, that's what I am going to do." I was a mature athlete who had been down a pretty long road already and given up quite a bit of childhood and adolescence for this dream.

Two things happened in the summer of 1966. I guess this is when the word champion in our lives — no matter what we do — really comes up. Everything is great and everything is easy when it all just comes in your lap and you barely have to work for it, but when the obstacles come along and you still dig down, then you build character.

I first came down with something called viral endocarditis. It's a virus that surrounds the endocardium of the heart. That was tough. I had lost a lot of weight and I was in the hospital for a while and at home. A sport like swimming is a conditioning sport. If you miss a month or two or three or four, it's very difficult to get back to your previous level and everybody else has been passing you by.

Just so you can appreciate it because I know a lot of people realize what weights are, I am not that big a person. I am 5'6" and 125 pounds, but I used to take 30-pound weights to do shoulder flies because for swimming you have to have tremendously strong shoulders. I used 30-pound weights for repetitions.

When I got out of that sick bed at the end of four months, I couldn't lift five-pound weights, not once. I couldn't get one repetition of a five-pound weight up. So I had a very long road in front of me. It was a depressing year and I was way slower than my times. It was 1967 now. I was only a year away from that Mexico City dream I had. Then all of a sudden that summer, things started to come back again. I started to feel a little bit of zip off the block. I was almost back to my old times. I wasn't winning the U.S. Nationals, but I was coming in fourth and fifth that summer.

Then at the state meet in 1967 — it's difficult for me to talk about even though it was so long ago — my life changed. I have just begun to talk about it and decided it's important if you are going to take a look at your life that you have to be honest about it. If anybody else is going through the same situation with your children or kids that you know, I feel it's important to talk about it as well. You can't stop anything by keeping quiet.

I was a member of a high school team with a bunch of very talented swimmers. We were all very close to that coach I told you about. We used to babysit his kids. We were part of his family. Then the afternoon of the state championship meet, I was over at his house and had taken a nap to get some rest before the finals. In an unforgettable span of perhaps two or three minutes, I suffered a violent, as I said, unforgettable rape at the hands of that coach — that coach who supposedly loved me like a daughter and cherished my future and my person. To say that I was in shock would be an understatement.

To tell you the real truth, I don't think I even knew what happened. I was a naive kid who hadn't been into boyfriends yet at all. My whole life was swimming.

I lost that night at the state level. I lost at the state meet and all the kids on the team knew something was wrong. They thought I was coming down with the flu or something. At the end of the meet all those kids, my teammates with whom I usually would be right in the thick of things, and the captain of the team over on the other side of the pool getting on their sweatsuits and celebrating, about to go out for pizza and coke. Well, I went into the diving well and went to the bottom of the pool. I don't know why, I think it just has to do with something like that vague word of character, but I screamed, "No" at the top of my lungs. If I had been up at the surface, you could have heard me around the world I think. I think that "No" was just in defiance. It was just an attitude that said this didn't happen to me. This isn't going to ruin my life. I was like a tough little soldier and I just pretended it didn't happen and I swept it under the rug.

That year went by and all of a sudden I wasn't the first one at practice anymore. I had always been the first person at practice and the last one to leave. Now I wasn't the first person there and I wasn't the last person to stay either. I was afraid. I was afraid to be around him. I was afraid that the other kids might know something. Life changed. That great mentor was no longer the person I admired.

It came to the Olympic trials in Mexico City and I really hadn't had the big speed that I'd had two years ago. Sports are funny that way. You peak and you don't know why, but sometimes you can't reach that peak again. Somehow, to tell you the truth I think it was by the grace of God, I made it into the final eight. The Olympic trials were at Long Beach. Eight people are going to go for the three top spots. Three people would then get to go to Mexico City and wear the navy blue U.S.A. sweats and would get to swim for the United States and march in the opening ceremonies. The rest of us were going to go on with the rest of our lives.

I remember it like it was yesterday. Walking down that pool deck to that 100-meter back stroke, a one-minute race, more or less. I was so full of fear that I was almost paralyzed. I wasn't blinking, my breath was caught up tight in the top of my chest. You know how it is when you are afraid — you can't do anything. A friend came to me and said the most brilliant words of wisdom I have ever heard. It maybe wasn't very poetic, but it was brilliant. I now try to live my life every single day according to these words. She was a 16-year-old girl. She grabbed my shoulders when she saw what was going on and she shook me and said, "Diana, Diana, wake

up. You've got the weight of your world on your shoulders. I see you have this dream, but you can't think about all that big stuff. You have to get it down like the tennis players say, you just watch the fuzz of the ball. You don't think about the big picture or the match and the tournament. You have to think about something small to focus on. How about a fingernail? Why don't you just blast off the blocks with your guts and your heart and your shoulders and your will and dig in and when you finish, don't look up at the electronic scoreboard. Don't look around and up and down the pool. Close your eyes and close yours fists and say, 'I couldn't have done it a fingernail faster.'" She said, "If you can say that and mean it, I guarantee it won't matter what happens."

Well, all of a sudden, she was right. I got rid of the weight of the world. I decided to think about all of that stuff later. I just started to focus in on a sliver of a fingernail. I got up to the blocks and my breath was now deep instead of shallow and I had some courage. I felt the strength and I blasted off the blocks with my shoulders and my heart and my guts and my will and I dug in. When I hit the wall, I had no earthly idea if I was first or eighth. I closed my eyes and I closed my fists and I said, "I couldn't have done it a fingernail faster," and I meant it. I looked up at the electronic scoreboard and I was sixth. I didn't go to Mexico City after all that. But, you know what? That 16-year-old girl was so right. I went over and shook hands with the three girls who made it and I marched into the locker room and I looked in the mirror and I said, "You know what, it wasn't just that 100-meter race, you did it all for ten years, every single practice, every meet, you did it so you couldn't have done it a fingernail faster. And that's okay."

I then marched on to the rest of my life. I went off to college and graduate school like everybody else, but there was still a fire in the belly. I had this talent. I could move through the water and I had so much desire left. It wasn't bitterness for not making it. It was just desire. I wanted that Olympic experience. There were no college scholarships for women at that time.

My speed had peaked and fallen off a bit. Then a friend came and started talking to me about this very wacky sport of marathon swimming. He told me the men swim together with the women. There is no differentiation in the genders in this sport. That kind of intrigued me. He said that the waters were always cold with very rough seas. Basically he said to me, "Diana, this sport touches on masochism to a certain degree. I just think this would appeal to you." (Laughter)

I found myself later that summer, after training and getting back in shape again, standing on the shore of Lake Ontario. Now I don't know if you know Lake Ontario, but you swim from Niagara on the Lake across 40 miles to Toronto. The water is 48 degrees. You dive in and your fingers spread and your jaw clenches and it's pure willpower alone that will allow you to continue. I was standing on the beach about five minutes before race time getting greased with ten pounds of wool fat lanolin which is a singular experience unto itself. (Laughter)

I noticed there was a big, burly muscular group of Egyptian guys over on the shore. The sport is very popular in Egypt. There was a tall, lanky, muscular group of Argentine guys over there as well. They were also getting greased down and ready. With about two minutes before the race, the best woman distance swimmer in the world came swaggering across the beach to introduce hereself to me. She was a Dutch woman and was 6'1" and weighed 182 pounds. She looked a little more like a linebacker for the Chicago Bears than she did a swimmer. I just thought briefly that the beach shook as she walked. As she got up to me, she took an index finger and jabbed it in the grease on my chest and she jabbed it with every syllable. I had a bruise this big for a month afterwards. She said, "I hear you are very good swimmer. Well, you are not going to beat me."

She swaggered off and now there was no doubt the beach was trembling with every step she took. I said to my trainer, "I'm not going in. These people are animals." I just realized for the first time or so that I wasn't going to have my own lane. This was going to be a big mass exodus into the water. The gun went off and I went tearing down the beach swearing in Arabic

like all the other guys. Well, I got into that freezing water and the day went by. You are never allowed to touch the boat or hold on or use any kind of flotation device, but you can stop and get sustenance from the boat. They also hold up a huge blackboard and tell you where you are and how much time to go. They take different tacks to see if they can beat the currents and the winds. People were dropping out and people were dropping back.

Well, I finished third among the men that day. There were 200 men swimming in this race. I also finished first among the woman. So the Dutch woman later that day announced her retirement from the whole sport. I mean, this is great power! I retired someone out of the sport and I just loved it.

I couldn't believe it, but I started traveling around the world. I can't believe how long it lasted, but I did it for ten years. I went from swimming down the Nile and the Ganges and across the Bay of Naples in Italy to swimming off the coast of Argentina and Mexico. The earth is four-fifths water and basically during the year we swam most of the lakes, rivers, and oceans.

Well, talk about building character. When you are in a plane flying over Lake Ontario and you see how unforgiving that body of water is and that your little measly body and your tremendous never-say-die willpower will not give up on that Lake, it stays with you. It stays with you as far as I can tell at this age for the rest of your life.

Since you can't do these things forever, it's time to grow up and get a job and move on. I was just about 30 years of age and I decided to do the biggest, most egocentric unforgettable swim that has ever been done. All of these other swims I had done were races and I decided to do a solo swim. I wanted to do something nobody else would ever even contemplate. I decided to do 100 miles in the open ocean. The record at that time was 60 miles and my trainer said to me, "That's great. We could do 62 or 65 miles. Why do we have to bump it all the way up to 100? " "No," I said, "I want it to be fantastic. Almost undoable."

We started to gather together the nautical charts of the earth's surface in my apartment. We threw out the antarctic and other unrealistic places and we came down to Cuba. It's so magical. Since 1959, everybody in this country knows where Cuba is. It's 102.5 statute miles from Key West to Havana. You would have to go from Havana to Key West. I wanted to finish in my country anyway.

I started to get in shape for this. I thought I had always been in shape, but this was going to be something different. It was probably going to take two non-stop days of swimming in the open sea across the Gulf Stream, which is kind of a river that flows within the sea. I got a lot of people researching it. I got some research money together. The second largest species of sharks in the world swims across the north coast of Cuba, so there had to be some precautions taken there.

I started to swim every day. If you know the Florida coast at all, I was swimming from Miami to Fort Lauderdale. It was a stretch of 32 miles and I swam it every day. The English Channel is 21 miles. It's cold, but it's short. It's 21 miles. I was swimming 32 miles every single day to get in shape for this. That would take somewhere from eight to ten hours depending on the currents and the tides. I also did 1,000 situps consecutively every day.

At the end of a year's training, I was in shape, and I had a crew of a 52 people who were shark experts who have been trained by Jacques Cousteau to watch out with sonar for the bodies underneath. There were NASA experts who knew about the intake of glycogen because I was going to be in there for so many hours. I was going to lose a lot of body weight and I had to keep up my glycogen level. I had navigational experts. This is 103 miles as the crow flies, so every little bit that you are off going left and right, et cetera, you are going to end up swimming many more miles than planned. So I had the America's Cup navigator volunteer his time to set me a course and change that course every 15 minutes to go from A to B as quickly as possible. All I had to do was gain some weight. Well, I sat in my hotel room in Havana thinking positive thoughts no matter what comes my way. No matter how many hours I am in

there, do not give up. Don't give in to the pain. Don't give in to the discomfort. Don't give up on your beliefs. I was trying to gain weight to put on a little extra before the swim. The navigator chose the day and we came down in the morning and I saw white caps. I had been in this sport a long time and you don't ever start with white caps. If they come up later, you don't blame anybody. Well, I got on the walkie talkie with the America's cup navigator and I said, "Rich, what the heck is going on here? There's white caps." He said, "Don't worry. There's a little easterly coastal breeze this time of year off Cuba. Go for it." He's the America's cup navigator and I have my six trainers on the beach with shrunken shoulders and thumbs because we all knew better, but I can't do everything. He chose the day. We only had visas and money enough for this one effort this year. We had trained for an entire year. It was tremendous dedication and sense of adventure for setting history.

Well, we start off and eight hours later we are in an eight-foot sea. Are any of you boaters? Do you know what an eight-foot sea is? If I am swimming at surface here, we are talking about waves that are breaking up at the second set of lines on this wall. In an eight-foot sea, you are no longer swimming smoothly across the surface to give your body a break. Your legs should be just kind of trailing lightly in the ocean, but now I'm driving the legs so I can get up on top of those swells and get some oxygen.

Did I mention the sharks? They like to see you from the boat. They like to see you all the time and when you are in an eight-foot swell, sometimes they don't see you for five, six, seven, eight, or ten minutes at a time and they get very nervous. I can't tell where the heck I am going because I can't see the boat. I am turning 60 times a minute this way and I don't see the boat for five, six, seven, eight minutes. So I'm going all over the place. At the eighth hour my trainer stopped over the swells, and it took awhile, but we had basically this conversation, "Diana, You've got a bad attitude. You are swearing at Rich every other stroke and losing a lot of oxygen." I yelled back, "I tell you what. You remove Rich from my sight for all time, not just for this swim, but for all time, and I'll get a better attitude."

Now we are in a 30-knot wind. I am trying to swim at three degrees north northeast from Havana to Key West. The wind is coming out of the east at 30 knots. It's a tremendous sea and we dug in with great attitude. There were problems. At the 12th hour, the NBC boat sank and all of their people and materials had to be brought over onto our vessels. (Laughter)

As I told you, I was never allowed to touch the boat. I was never allowed to hold onto a rope or sit on a kickboard or use flippers or any kind of flotation, but I swam over close to the boat every hour. They would call me with a police whistle signal. They would give me a cup of hot sustenance or glucose or they would put a tube in my mouth and I would tread water to take it in. During that short 30-second pit stop, you urinate or do whatever you have to do. They give you information from the boat and I know things are tough. They are all sunburned and they are all seasick. And I'm not feeling so great myself. We are making progress, but I have been told that I am swimming okay to the north, but the wind is blowing us to the west.

You must reach land. You can't just get out and say, "Do you remember the time I swam to latitude 38, longitude 56?" You have to reach land. That is the cardinal rule in the sport. Unbeknownst to me, land, as we went, was becoming more and more unreachable. We were getting blown into the Gulf of Mexico past any reachable land. We got to the 25th hour and the 30th hour and the 35th hour and the 40th hour. Well, I guess they prayed and every atheist on board converted to something or other. They tried unique navigational configurations. They tried everything. Well, finally at 41 hours 49 minutes, my trainer, again with the bullhorn, yelled across the swells and we had a very emotional conversation by which I yelled and pleaded and cried and she yelled and pleaded and cried. She told me that land was no longer reachable. So now it was just an act of cruelty to keep me in the water because we weren't going to make it anywhere.

Well, I was handed up. I had lost 29 pounds. Even with eating glucose every hour in the really heavy surf, there was so much duress on the body that I couldn't keep up with the weight loss. I had lost 29 pounds, so I was down to 101 pounds. I was very, very skinny for my height. I was handed out to a Coast Guard captain for safety and he was going to take me back to Florida. I had never met him before and he had never met me. He had joined our group 12 miles into international waters so he had been with the swim for almost the whole time and witnessed everybody's courage and everybody's efforts.

I think he pretty much summed it up with a statement not just about me, but about all of us. He had me cradled in his arms for just a minute while they were getting some blankets ready on the deck. He looked like what I thought all sea captains should look like. He had a big shock of silver hair and big pools of blue eyes. He was sturdy and well built. He was holding me and our faces came very close for just a second and he got all choked up. I saw the tears in his eyes and I was pretty beat. I was just lifeless. Then he said to me, "Honey, if we ever go to war, I want you leading our army, all right?" It was just his way of saying that this was a phenomenal effort. We all knew that if we had a different navigator to choose the day and we had a little better break in the weather, we could do it.

So it took a while to heal up, but I did heal up. We gathered that whole group together again. We got rid of the navigator and got somebody else into that position. (Laughter) The next year was 1979 and Cuba was closed to Americans in terms of visas. We could not get in there whatsoever and I was disappointed because that was the magical geography I wanted to cross. However, we were ready to do the swim and ready to set the world record of 100 miles. We decided to go to the Bahamas. The Island of Biminis lays about the same distance off Florida as Cuba does, but it's out to the east. So now the swim is going to be straight across the Gulf Stream trying to break across that river and into the coast of Florida somewhere around Jupiter or Stuart, Florida.

When I came down to the shore this time, I saw a sea of glass like a skating pond. We were all so excited to have the luck of the weather that we decided to click off the quickest possible miles just in case something horrible came up. Once again, a couple of days went by and I never looked up. That's one thing you never do. You only breathe to the side and follow the boat that is setting the course because if you look up, all you are going to see is depressing horizon. You know what I mean? If you just see that horizon time after time, you just get depressed. So you look to the side and just go where they say you are supposed to go.

At the 42-hour mark, once again, it was the exact same time, I guess I had a little tantrum and I said something I shouldn't have said to my trainer. I hurt her feelings, I guess. Well, I looked up on the next stroke and she is giving me the finger. I thought, okay, maybe I was impolite, but we are not out here to be polite. We have to get something done and I said something I shouldn't have said. I'll apologize to her later. But I didn't think I deserved this. We were supposed to be a team. She is supposed to be on my side no matter what. I was angry at her and I thought, I'm not going to look at her for the rest of the swim. I am going to breathe over the other way. I am going to look at the boat that has all the press people on it. It had about 100 people with guys from Sports Illustrated I know and guys from a lot of other papers and news organization I don't know. There were 100 of them — I'm not exaggerating. Fine, I thought, I'll breathe over this way. Well, the next time all of them — and they don't know me that well — give me the finger! All of them! I thought, that's it. Such ingratitude. How can people treat you this way? Have I been unsportsmanlike? I am not going to breathe for about 30 seconds and keep my head down and think about this.

I took a couple of strokes and I heard the police whistle which means stop. It's the signal for sharks which means stop in your tracks. It doesn't matter what you are doing, who's right or wrong, you just stop. So I heard the signal and I stopped and I looked up and through these

fogged over goggles and those tired eyes, I started to see the flotilla of boats that were coming in and all the people who had come out to follow us during the day along with my own personal boats. Well, I started to see them and they were all pointing — the index finger this time — and they were pointing towards shore and they were chanting, "One mile! One mile! one mile!" I looked up and got my goggles up on the forehead and it wasn't the vision of the pyramids that my Egyptian father said would be at the end of the great marathon, it was condominium buildings all over the shore of Florida. (Laughter) What a sweet sight that was. It wasn't the fastest mile I had ever swam, but it was the sweetest. I came very close to the boat. I couldn't touch it, but I came close to all my friends and adventurers who had given up so much of their time. They will be friends forever for what they gave to me and we shared in history. I crawled up onto the beach and that was the longest swim ever done by either man or woman. It was 102.5 miles without a shark cage. That world record still stands today.

I got very lucky. I got hired by the Wide World of Sports. Usually you come out of sports and to be hired by network television you have to come from a fairly major sport, either football or world class tennis or something like that. But I was in this eccentric sport of marathon swimming. I had done a lot of television, though, and I had the gift of the gab, shall we say. I was hired by Wide World of Sports and had always wanted to say, "The thrill of victory and the agony of defeat," on the air.

Now I was working, making great money, had a great relationship, but something was missing. I was feeling kind of blue and a friend of mine said, "What's up with you? You have the tiger by the tail. Everything in life is on your side. How could you be down?" I said, "I don't know. I just miss swimming. I miss the intensity of it. I miss when I go to sleep at night knowing exactly what I want to do for the next five years and how I'm going to get there." She said, "That's not swimming. That's you. That's life. If that's what you want to do with life, if that's what turns you on, get intense about whatever it is you are doing. Go to sleep at night with a passion and a vision." She was right.

I started wanting to become a great communicator on television and work all the great shows. It may not sound like much to you, but very shortly after that I was given an assignment at the 1984 Olympics by ABC to cover swimming during the first week. Well, that was great. A lot of people watch swimming during the Olympic games obviously. I was very privileged to be there. However, during the second week, which meant more to me as a broadcaster, I was going to be the play-by-play person. You know what I mean? I was going to be the main voice or the person who introduces the event and gets you excited about it and gives you the history and takes you through all the events.

You work with a color commentator who is really from the sport. He gives the analysis. I was going to be the play-by-play person at the Olympics on canoeing and kayaking. So these are minor sports, nevertheless, this is live television and I had never worked live television before. This was going to cut my chops as a broadcaster.

Well, I get there and you are outdoors on a podium because you are going to watch the event on monitors located on the podium and the race starts 1,000 meters away. As they come down here, you are calling it off your monitors. You look up with the naked eye to the finish line right in front of you.

I had been researching canoeing and kayaking for six months. I had been to Romania, Bulgaria, and Yugoslavia, where all the great kayakers and canoers come from. I knew everything about it. I had been in all the boats to get an aesthetic feel of what the rhythm is like and what muscles it takes.

My color commentator has not only never worked live television, he has never been on television. He is scared to death. His skin was as white as this sheet of paper. With a minute to go before the broadcast, he is asking me if his beard looks all right. I'm trying to calm him

down. I have all my notes taped around with all the little details about the sport, all the names, and all the phonetic spellings of the names because they are all bizarre. I had been interviewing the president of the Romanian Canoeing Association. I have his name down here also. They are coming down with last minute instructions in my headphones. "Diana, don't forget now, tonight is the night that Mary Lou goes for the gold at the vault, so tease that a little bit. Don't forget Howard Cossell is at boxing tonight. Get that going a little bit."

So I am making last minute notes and I have never done this before. I'm trying to stay calm and with 30 seconds to go, Lenny, the videotape technician who is always a very cool guy comes sprinting out of the broadcast booth and towards us. We know something is very wrong. This guy starts grabbing my forearm real tight. He's nervous and Lenny comes over and says, "Guys, we have a really huge problem. Our video is screwed up. For the first couple of races until we can get to the commercial, you are going to have to read your monitors flipped vertically. So the people at home are seeing vertically different from you. Lane one is really lane eight. Lane two is lane seven. Lane three is lane six. (Laughter) This guy next to me is drawing blood now and I forgot my name. (Laughter) I was in a total panic. Lenny grabbed my shoulders and says, "Hey, aren't you the one that swam with the sharks and all that? Come on, get tough, handle it."

Those are two other words of wisdom that I always remember — handle it. That's just it. Don't analyze it, just handle it. I'm trying to get myself together and now they are coming on the headphones to me with "22, 21," and the producer comes on one more time and says, "Diana, we just got an interview with the president. We have to do it before the first commercial. So after the first race, Jay, you carry the ball." Oh, sure, he's going to carry the ball! "Diana, drop off your headphones and rush over and get the interview with the president." So I'm looking for my notes on the Romanian canoeing president and as they are counting down from "15, 14," I said, "That's fine. You just throw everything at us at the last second. Now I want the name of that president exactly pronounced and what he does." She says, "All right." They are still counting down, "ten, nine." She then says very slowly, "His name is R-o-n-a-l-d R-e-a-g-a-n, but I'm not sure what he does." (Laughter)

So I was not Jim McKay that day. But you know what? He and I, we got it together. We were okay. The point was that the friend of mine was right. It wasn't swimming. Just like I said in the beginning. There was a lot of talk about swimming in this presentation, but it's not really about swimming, is it? It was about teamwork. It was about desire. It was about a future vision and knowing what you have to do day to day to get to that vision. It's about sacrifice. It's about pride and character.

It's the exact same life I am living today. I just turned 48 and I feel vital. I feel as proud of myself as I did when I was standing on those shores having looked back on a stretch of water that I beat and had seemed impossible to beat. It's just in a different venue.

The truth is it sounds corny, but I mean it so genuinely that the words of that 16-year-old girl are honestly what I live by every day. I don't care whether it's speaking to you and looking around at your faces, and I thank you for your interest because I see it's there. I don't care whether it's sitting down to talk to my 14-year-old nephew about sex, because that's what is happening. It's so scary, but it's real life. I don't care whether it's my marriage or my job. I do every minute of every day I am awake so I can't do a fingernail better. I don't always win and I don't always get every job I want. Tragedy comes into my life just like everybody else. However, I know that when the day comes for me to pass from this earth, I am going to look in the mirror just like I did missing the Olympic games from Mexico City and I am going to say, "You know what? You did it. You did it all so you couldn't do it a fingernail better." And it's going to be all right.

I thank you very much for your time. (Applause)

Mr. Shiloh: Thank you, Diana, for your really touching and emotional and inspirational speech. As a token of our appreciation, I want to give you a hat. It's not an expensive hat, but it's now a collectible. I don't know if you know this, but we are here representing four organizations who just a few hours ago decided to merge into one. We are now one team.

We all know that life is a marathon run. Diana, thank you very much.

Ms. Nyad: Thank you very much.

Mr. Shiloh: At this time, we will have a short recess.

Roadmasters will reconvene at 10:00 a.m. and B&B will meet in Room 4300. Thank you. (Recess)

BRIDGE AND BUILDING SESSION

Tuesday, September 9, 1997

PRESIDENT's ADDRESS

President Lileikis: Good morning and welcome to the opening session of the 102nd Bridge and Building conference. Little did I know when I joined the B&B Association in 1980 that I would be given the opportunity to actually offer up a presentation shortly after joining the group. A lot of you in here were probably there. I must have done okay because I was asked to come back to give another presentation the following year. In reality, I soon found out that once you give a presentation, the rest of the board has the realization that you are stupid enough to do the required worked needed to do the presentation, so they volunteer you for another one. Whether or not you know anything about the subject is pretty much immaterial. (Laughter)

Who would have thought that I would actually have the opportunity to preside over this organization as president. This past year has been, and I know all the past presidents have said this, rather challenging. A tremendous amount of time and effort have gone into the daily occurrences of the organization. This, honestly, could not have been successfully accomplished without the help of the other board members, the past board members, and of course, the Homewood office.

For those of you haven't yet heard, our members have agreed to merge with the Roadmasters and the AREA. Let me be the first to tell you that this has really been a tremendously easy ordeal consisting of monthly meetings, conferences, flying here, traveling there, making sure there is a synopsis of the meeting put together and sent out, along with some arguing between the associations. A piece of cake really. Now, if any of you believe me, I have some literature here on some swamp land down in Louisiana. (Laughter)

Being the president of this Association has truly been an honor for me. I think back when I first began my career with the railroad industry. It was April 24, 1981. I walked into the doors of Union Pacific Railroad in Omaha, went straight up the elevator to the 10th floor where the Bridge and Building Department was, and went straight into the design office ready, willing, and able to put my stamp on railroad engineering. Now, to put this in proper perspective, three

weeks prior to that I was interviewed by the bridge engineer. I quit my job at an architectural engineering firm, put my life in order, if that's possible, and made the trip downtown to Union Pacific.

So here's my first day: I am fresh, unsoiled, a true railroad novice. I walk into the office and within minutes the bridge engineer, the guy who interviewed me and hired me, walks up. Of course I was sitting right outside his office waiting for him to show up. I stick out my hand and I say, "Good morning." Well, he looks at me and says, "Who are you? Do I know you?" I said, "Wait a minute, you hired me." "I did? Oh okay," he says. So this is really a positive sign, right?

Well, he takes me over and introduces me to the guy I was going to work for at the time, Jim Beran. Well, needless to say, my career at Union Pacific was almost over when I was first introduced to Jim. I think it was a guy by the name of Bob O'Connor who told me that Jim is a graduate of Notre Dame. Well, I'm a graduate of Nebraska, so I said, "Gee, that's too bad." Not exactly your smartest words for your first day on the job. Well, needless to say Jim was wonderful. He had been tabbed Einstein by a few people within the department. Jim was sitting there bent over his desk and wearing a 1970s pair of dark-rimmed glasses — this was 1980 — but at that point in time his head shot up and he was looking at me through these horn-rimmed glasses with these beady eyes. I knew I was gone. I'm out of here. We ended up spending the rest of my first day talking about Nebraska and Notre Dame football. To this date, we still share an anecdote or two.

During my career at Union Pacific, Jim Beran and John Horney did more to prepare me for life as it is today than anything that I think has happened to me in the past. With the help and assistance and prodding of Jim and John and a guy by the name of Jerry Edwards in Salt Lake, I became a more rounded individual ready to face and accept the challenges that this industry thrusts at us daily. I actually at times find my myself trying to create new challenges. I guess it makes things more interesting that way.

As all of you know and a lot of you know better than others, we are constantly changing in this industry especially in the last ten years. With the merger of many of the Class 1s, the new technologies and equipment we have been faced with and having to adapt to a myriad of circumstances and challenges, collectively, I think the challenges put before us have been successfully met. In conversations with my peers, it amazes me how similar situations have been handled in different ways. That has been the beauty of our organization. We get a chance to convene, we get a chance to converse with others, share ideas and thoughts and even listen attentively to those who single-handedly built hundreds of miles of railroad or directed the rehabilitation of a derailment site for four days and nights without any sleep and still functioned.

We are sort of a fraternity. Once the blood of working on a railroad gets into your system, it's really tough to get it out of you. Well, this fraternity is growing now. With the merger, we now have a greater chance of communication and sharing. I don't look at this conference as being the last one of the B&B Association, but as the beginning of something great to come — one where I think we can work closely with all of the rest of our railroad brethren, and one where hopefully all of the titles people have will be subdued. Yes, we will still have CEOs, chief engineers, VPOs, et cetera. We need those and they are essentially running a business and a company. But in this new organization, it won't matter if you are a chief engineer or a manager, but rather what you do. We all have an equal role to play in this group.

I encourage everyone here to actively take part in the new organization. I think collectively we will make a difference. Individual work is obviously required to make this group grow and individual commitment must be made. Trust me. It's really well worth the time and the effort.

Thank you for giving me the chance and the opportunity to lead this organization this year. I hope when we look back at my term in the upcoming years, it will be remembered in a positive occurrence and with the advancements that we have made.

My thanks, again, must go out to the following board members and especially to Bob Carter for his diligence and perseverance in putting this program together, to Jimmy Neece for his help and assistance on our seminars, and to Dave Franz and Mark Walbrun for their hard work and diligence with respect to the merger committee. The entire Association, I think as a whole, needs to receive my personal thanks also. I plan on staying active within the Association and, again, ask each and every one of you to become more active. Thank you. (Applause)

Without further ado, I would like to introduce the past presidents who are with us today. I ask that they come up to the podium, and that you please hold your applause until all have been introduced. We will start from the newest guy to the oldest guy. Mike Bradley, Conrail, president 1995-1996; Don Steele, Union Pacific, president, 1993-1994; Paul Saletnik, Edwards and Kelcey, president, 1992-1993; Mark Walbrun, TranSystems, president 1991-1992; John Horney, Carter Burgess, president, 1990-1991; Byron Burns, BNSF, president 1989-1990; Ray Tallent, Norfolk Southern 1988-1989; Don Lewis, Illinois Central, president 1987-1988; John Kapp, Conrail, president 1986-1987; and Jim Budzileni, (retired), Illinois Central, president, 1983-1984. Our past presidents. (Applause)

There are three vacancies for honorary membership. As you know the category is limited to ten. I would like to propose those three positions be filled by Wally Sturm, Jack Williams, and Jim Michel.

Wally is a past president and was elected to the board in 1973 and became president in 1978 through 1979. He presented several committee reports prior to serving as director and has been a member of the auditing committee since 1981.

Jack Williams, also a past president, was elected to the board in 1968 and became president in 1975 through 1976. He presented several committee reports prior to serving as director and has been on the auditing committee also since 1981.

Jim Michel served as director from 1979 through 1982. He presented special features and contributed to committee reports prior to serving on the board. Jim also wrote and prepared the B&B newsletter from 1982 to 1987. He served as B&B's alternate member on the original merger study committee and served as a member of the bylaws constitution committee for the newly merged association.

I would like a motion to elect the three gentlemen, Wally, Jack, and Jim to honorary membership status. Do I have a motion? So moved. Do I have a second? Thank you. All in favor, please say, "aye." All opposed? The motion is presented, seconded and carried. The aforementioned members are elected to Honorary membership and will be duly notified.

John, would you like to give us information on the scholarship?

Paul Saletnik, Don Steele, Byron Burns, John Kapp, John Horney, Don Lewis, Jim Budzileni.

Mr. Horney: As you all know, several years ago we started a program to have a scholarship available to our members and their dependents. I think that is one of the most significant and proudest parts that I have ever played in the Association. Money for these scholarships comes from our revenues generated from the seminars that we hold. Again, I think that depicts the whole purpose of our Association — the training and bringing on of information to our members.

This year, I actually regret to announce we never had any applications for a new scholarship. We are giving away two scholarships a year to the members of the Association and their dependents. This year we had no applications. That's really too bad.

The candidates must be of junior status in college. A junior in college is awarded the scholarship and it is renewable. At the senior year, if they maintain the grade point average, it is renewed automatically. The grade point average is the only stipulation.

With that, I do have good news. We do have a renewal of a scholarship that we gave last year to Jamie Hill. Jamie is the son of Gary Hill with the Union Pacific Railroad.

Engineering curriculum is not a criteria for this scholarship. We have given them to fields of theology and psychology and as well as engineering. It's kind of exciting, however, that Jamie Hill is, in fact, obtaining his engineering degree at the University of Nebraska and is carrying well over a 3.0 average which is pretty exciting. As you know, a 3.0 average or better in engineering is nothing to sneeze at. So we are giving $1,000 this year as a continuation for Jamie Hill.

To my knowledge the scholarships will continue. Now, don't ignore this, members of the Association, this is a great opportunity which we would like to pass on as part of our Association. That's what we have this year.

Mr. Lileikis: Thank you, John.

At this time I would like to have Willie Benton come up. Willie will give us the membership report followed by the necrology report.

MEMBERSHIP REPORT

Active Members	634
Junior Members	1
Associate Members	108
Life Members	34
Honorary members	7
Total	**784**

NECROLOGY REPORT

It is with grief and regret that we report the known loss of the following members through death during the past year. It is possible that other members have passed away during the year of which we have no information.

If you know of any, please report their names to the secretary.

The following have been reported deceased during our last annual conference:

William Huffman	Asst VP Chief Engr. (Ret)	C&NW
Michael Wisniowicz	Asst Supvr Structures	Conrail

If you would all please stand and join with me for a moment of silence for these gentlemen, I would appreciate it. Thank you.

Mr. Lileikis: Thank you, Willie.

Don Lewis, would you please present us with the treasurer's report.

TREASURER's REPORT

September 1, 1996, through August 31, 1997

Checking account balance, Sept. 1		$11,333
Receipts		
Dues	$10,210	
Advertising	7,825	
Bridge Repair Seminar	17,075	
Bridge Inspection Seminar	19,925	
Merger Expenses	3,026	
Interest on checking account	223	
Miscellaneous	433	58,717
Transfer funds – money market		26,500
		96,550
Disbursements		
Salaries	$17,431	
Payroll taxes	1,406	
Employee savings	523	
Office rent, utilities, insu. & taxes	3,716	
Office supplies	378	
Equipment purchase, rent & repair	435	
Stationary & printing	3,867	
Postage	3,919	
Merger	16,693	
RT&S Subscription	4,771	
Bridge Inspection Seminar	12,546	
Bridge Repair Seminar	9,053	
Bridge Handbook	2,868	
1996 Proceedings	13,216	
Executive Committee meetings	3,591	
Temp. office help & computer constlnt.	704	
Dallas 2001 Conference	775	
Scholarship		
Miscellaneous	297	96,189
Checking account balance, August 31		361
Funds on deposit – Advance Bank, Homewood, IL		7,796
Total funds estimated, August 31, 1997		$ 8,157

Mr. Lileikis: Thank you, Don.
Mr. Budzileni, would you give us the Auditor's Report, please.

AUDITOR's REPORT

The undersigned, Jack Williams, Wally Sturm, and I have examined the books of the secretary and the treasurer and as of September 1, 1996, through August 31, 1997, have found them to be correct. This is as of August 31, 1997.

(Signed) Jack Williams
Wally Sturm
Jim Budzileni

Mr. Lileikis: That concludes our business session. Do I have a motion to accept the reports as presented, please? Thank you. Gordon, a second? We have a second, thank you. All in favor. Aye. Thank you. All opposed? The ayes have it again.

The above reports are accepted as presented.

I am going to turn the podium over to Don so we can go ahead and get the presentations going.

Mr. Lewis: As many of you know, I am going to be one of the functional vice presidents in the new organization. It doesn't matter who it is. We are still going to have the B&B Association, maybe with a different name or something like that, but we are going to operate very similarly to how we do now. The big thing is we need your support to do it.

This next year, in setting it all up is going to very difficult. Bob Carter is going to be the chairman of the Maintenance Committee. We are going to need your help. We don't know exactly how we are going to establish the committee or the guidelines that we have. This is all part of what we all call the learning experience we are going to have the next year. From my point of view, I am still going to rely on you to help the Maintenance Committee operate and come up with presentations and ideas. We are still going to have training sessions and things like that.

I know I didn't tell Joe I wanted to say this, but I want to reassure people in the audience that this is not the demise of the B&B Association. It's just a different name. We are still going to try and work the same way. I appreciate all of your help in the next few years and ongoing. Thank you. (Applause)

Mr. Carter: Good morning. I would like to thank both Don and Joe for their comments. Digressing a little bit from what Don was talking about, this is a good opportunity to solicit. We need presentations. We need state of the art timely presentations. To that end, I would appeal to you out there if you have ideas for presentations or if you are willing to be presenters, make me aware of it or make someone in the organization aware of it.

We took the position with the merger in assuming that it would go through, that it was better to be proactive and be ready to hit the ground running when that came about. I think with this committee we have a good start on that. There isn't anybody I have worked with in this organization who wants to see the B&B Association per se disappear. So I would solicit an appeal for your help in getting timely presentations and volunteers. If you are willing to do it today, come up to me and give me your card and phone numbers and ideas. You guys are the ones that the presentations are for; therefore, it's your support that we need.

Without further ado and getting on with the program, it is my pleasure to introduce Willie Benton who will, in turn, introduce the next presentation.

Mr. Benton: It's my pleasure this morning to introduce Doug Knuth from Edwards and Kelcey who is going to do our first presentation on concrete repair. I asked Doug to give me a little biography on what he would like me to say about him before he came up here. He gave it to me last night and I thought it was his whole presentation. After going through it; however, I managed to convert it to just four lines.

Doug graduated from the University of Missouri in Rolla in 1973. He has worked with C&NW and Milwaukee Road. He is now a principal with Edwards and Kelcey as senior assistant vice president and senior project manager and is more than qualified to give this presentation. I appreciate him doing it and I look forward to hearing his presentation.

CONCRETE STRUCTURE REPAIRS MAINTENANCE AND METHODS

Douglas Knuth

Principal
Edwards & Kelcey

Concrete has been used in railroad structures for most of this century. As a result, there is a wide range of concrete structures on our railroads today with a full range of problems. Fortunately, concrete is a material that is easily repaired.

This paper addresses some of the common problems found in concrete structures and how they can be successfully repaired. Many of the repairs made to concrete are not successful. While some failed repairs are due to poor repair materials, more are due to misapplication of the material or improper preparation. For a successful repair, there are six basic steps in the process.

Identify the problem
Determine the extent of the problem
Address the cause, not the symptom
Select an appropriate repair method
Prepare the surface
Make a proper application

Problem Identification

The first is to recognize the problem and properly identify it. This is typically done during regular inspections. Simple visual observation is the most important tool here. A key factor is the proper description of the problem and the clear transfer of that information. Use of accurate and consistent terminology by the inspector is critical. The difference between an open construction joint and a crack is important in determining the appropriate repairs.

One of the most consistent terminology problems is the use of the term "spall." Spalling is often used to identify two very different problems. The first is the true spall: Concrete is missing from the surface of the member, but the remaining material is hard and sound. The concrete has been broken off due to an impact, corrosion of the reinforcing, or other forces.

The other condition is where the concrete itself is gradually crumbling and flaking off. In this case, concrete falls off in small pieces and the remaining concrete is not hard and sound. The concrete will be cracked into small pieces and the deterioration will extend for some depth into the structure before sound concrete is reached. The required repair procedures for these two conditions are very different. Determine Extent

The next step is a detailed examination of the structure to determine the extent of the deterioration. This involves measurement of the size of cracks, depth to sound concrete, et cetera. This may be done using simple measurement techniques such as sounding, or involve more complicated procedures such as coring, ground penetrating radar, or ultrasonic testing to determine condition within the structure. The degree of investigation should be proportional to the size of the structure and the amount of visible deterioration and, therefore, the likely cost of the repair. The larger the project, the more worthwhile it will be to accurately determine the extent of the deterioration in advance. More investigation is also warranted where there is concern about the stability of the structure during proposed repairs. Determine and Address the Cause

The next step is to determine the cause of the deterioration and address it in the repairs. If the underlying cause is not addressed, the repair is likely to fail in the same manner as the original concrete.

Cracks

Stress-related cracks can occur due to overload from increased live load, added fill behind wing walls and abutments, or settlement of foundations or other movement. Where increased loads are the cause, a means of increasing the capacity needs to be addressed. Settlement may be ongoing or have stopped. Frozen bearings may cause the bridge seat to break as the spans contract. Hydraulic pressure from the water trapped behind abutments and wing walls may lead to freeze/thaw damage and increase overturning pressure. If these conditions are not addressed, the repair will also fail. Shrinkage cracks may not be a direct problem, but may indicate problems with the concrete mix or placement and predict future deterioration.

Spalling

Spalling occurs due to some physical force. The nature of the force should be identified and measures taken to eliminate it prior to the replacement of the concrete. A frequent cause is corrosion of reinforcement. The corrosion should be removed from the reinforcing bars prior to the repair, and sufficient space cleared around the reinforcing to get the repair material completely around it and bond to it. The repair should also prevent future moisture or corrosives from reaching the reinforcing bars.

Crumbling

Crumbling is usually due at least in part to poor quality concrete. The deterioration may be very deep into the member. In some cases, there may be no truly sound concrete. The extent of the deterioration is usually influenced by freeze/thaw or chemical attack. To be effective, repairs must either remove the deterioration to sound concrete or effectively confine and protect the concrete with new material. Shallow repairs on a base of soft or crumbling concrete will not have a long life. Surface Preparation

The first step in the actual repair is preparation of the surface. Most repairs require a clean, hard surface to effectively bond the repair material to the structure. The most common repair failures are due to poor preparation of the base materials. Where it is not possible to remove to sound material, the repair must be sufficient to stand on its own and not rely on the base material.

The repair material must be bonded to the original material. Many epoxy and polymer materials bond well to concrete, but some require a dry surface. When conventional concrete or shotcrete is used, a moist surface without standing water will provide the best bond. A dry surface will pull water out of the new material causing a weak bond. Epoxy bonding agents are available for bonding fresh concrete to existing concrete. These can provide an excellent bond when used correctly, but the fresh material must be placed while the epoxy is still tacky. If the epoxy has hardened, it can actually prevent a bond. The ability to place the repair material before the bonding agent sets should be considered in the decision to use a bonding agent.

Many of the bonding agents will form a moisture barrier. If there is moisture coming through the concrete, a path for that moisture must be provided, especially if the bonding agent will cut off other avenues. Weep holes or drains should be provided if necessary.

Repair Methods

Repairs fall into one of three basic categories:

- Partial removal and replacement
- Reinforcement and/or encasement, and
- Internal consolidation

Partial Removal and Replacement

Simple removal of the damaged or deteriorated concrete and replacement is the most common category of repair. Several different repair materials can be used. The most common

is simple cast-in-place concrete. This has the advantages of being commonly available, relatively inexpensive, and having properties similar to the original. Placement uses familiar methods and equipment. The disadvantages are that it is difficult to place from very thin sections on either horizontal or vertical surfaces. It requires form work for vertical surfaces, must be protected from freezing and takes considerable time to cure to achieve required strength. In many repair situations, the time for concrete to develop strength may not be available. Cold temperatures may restrict placement, especially for thin sections placed against cold concrete.

Another technique for placement is pneumatic concrete, also known as shotcrete. This method sprays a very dry, fine, aggregate mix at high velocity. Since shotcrete is still a Portland cement mix, the same temperature restrictions as for cast-in-place concrete apply. Shotcrete works well for thin sections on vertical surfaces. It eliminates the need for forms and can be placed much thinner than conventional concrete. Shotcrete also has a higher strength than most concrete. The principle disadvantages of shotcrete is the need for specialty equipment and experienced, trained operators. The techniques used by the nozzle operator are critical to successful placement.

Other disadvantages include a higher unit cost and the need for proper moist curing. Shotcrete has a lower moisture content than normal concrete and loss of water by drying will lead to shrinkage cracks. Unlike concrete, there is no form work to protect the new shotcrete during the initial curing period and poor curing is a common cause of failure. Finally, without forms, it can be difficult to get a smooth straight surface on the repair.

Another repair method using conventional Portland cement-based concrete is the use of precast elements. Precasting a replacement piece is a way to replace a section with a minimum of track time. This method is most commonly used for bearing areas and back walls. The use of conventional materials and fabrication make this an economical repair for tight time frame situations. However, the precast blocks can be heavy and difficult to place in tight locations and there is no ability to adjust the size at the time of placement. Thin pieces are likely to crack when placed under bearings.

A newer group of materials are the polymer concretes which use polymers instead of Portland cement in the concrete mix. The polymers are mixed with sand and sometimes pea gravel to form a concrete mix. These materials have very quick set times and can set up at a much lower temperatures than Portland cement. This makes them especially advantageous for bearing areas and other places where limited track time is available for the repair as well as for winter repairs.

The strength of polymer concrete not only develops quickly, but it can be much higher than normal concrete. Strengths of 10,000 psi in a couple of hours are possible. The high strength plus high resiliency make them perfect for areas under bridge bearings.

These materials have two other advantages. They come in preproportioned mixes, which reduces room for error in the field and they resist attack from many of the chemicals that affect Portland cement.

The cost of polymer concrete is much higher than Portland cement concrete so large quantities can be very expensive. Another concern is that some of the components of the mixes are chemicals that can be hazardous. The materials will vary between manufacturers. It is necessary to understand the properties of the particular product being used. If used regularly, it is best to buy one product consistently and train the crews in its proper use.

Reinforcement/Encasement

There are a number of reasons to externally reinforce concrete structures. External reinforcement can bridge across open cracks, provide additional load bearing capacity, provide a protective layer or provide a confining force.

The simplest method is to embed reinforcing in a concrete encasement. This encasement

will add at least several inches of thickness to the member. Where the surface concrete is poor, this may be compensated for by removal of the poor quality concrete. In other situations, room for the additional material must available, and the extra weight of the concrete must be considered. For large unreinforced piers and abutments of poor quality concrete, this method provides a confining force, bridges cracks and protects the older concrete from the elements. Confinement of poor quality material in a strong "box" greatly increases its structural capacity. This method uses conventional materials that are readily available and known installation methods.

Where the goal is to simply provide reinforcing across a crack, especially in unreinforced concrete, dowels may be drilled across the crack to stitch it together. This method has limited capacity, as there is a tendency for a crack to develop just beyond the stitches. For smaller reinforced members such as beams and columns, there may not be room for a concrete encasement. In this case a more direct reinforcement may be considered. Steel plates, fiberglass, and other synthetic fibers can be bonded directly to the concrete to provide reinforcing.

Fiberglass wraps can be used to encase columns. Fiberglass fabric is saturated with epoxy and wrapped around the column. After the epoxy cures, the fiberglass provides a hard encasement of the column. This provides confinement enhancing the strength of the column, encloses the concrete and any patches in the confinement improving their life and provides protection from salt spray. The thickness of the material can be as little as one quarter inch. Protective coatings are available to protect the fibers from ultraviolet light, abrasion, heat, et cetera. However, the material is still exposed to impacts and the weather. The conditions should be carefully considered. This method was originally developed to increase the earthquake resistance of columns in California.

Both steel plates and fibers can be used to add additional tension reinforcement to concrete. The materials are bonded directly to the surface of the concrete using epoxies. This allows the addition of reinforcing without the addition of concrete. Clearly, the strength of the bond to the concrete is the key to success in this solution. The concrete to which the reinforcing will be bonded must be clean and sound. The strength of the epoxy bond must be certain. Tests should be made of the epoxy and the bond before relying on the strength of the repair. It should also be understood that the repair is more susceptible to damage by fire than normal concrete.

For steel plate it may be possible to add mechanical fasteners such as bolts to the connection. This would provide an added measure of safety.

All of the bonded external reinforcements are specialty work. Either an experienced contractor should be used or a vendor of the materials with experience in similar applications should be involved. Internal Consolidation

The final category of repairs is filling of internal cracks and voids. There are two basic materials used for this purpose: Portland cement grouts and epoxy resins.

Portland cement grout is used where cracks or potential voids are large and high strength is not critical. The materials are locally available and costs are fairly low. The grain size prevents intrusion into small, tight cracks. Moisture is not a problem as long as flowing water will not wash the grout out of the cracks. This is the best material for stone masonry where large internal voids are possible. Cement grouts are typically injected through a large opening drilled to intercept voids or cracks. Preparation of the voids consists mainly of flushing with water to remove dirt and loose material.

Epoxy injection resins can be made in a wide variety of viscosities. This allows their use in open cracks to very tight cracks. The strength and bond strength of epoxies can be very high. Where the load carrying capacity of the crack repair is critical, epoxies are a superior choice. The cost per gallon is quite a bit higher than cement grouts so a good understanding of the quantity that will be required is important. Epoxy injection typically uses a paste epoxy to seal the front of the crack and the material is injected via small shallow ports. The preparation

involves a thorough cleaning of the cracks and possible drying to remove water. The epoxies may be formulated to bond in moist conditions or require dry conditions. Care must be taken that the drilling of the injection ports does not fill the cracks with cement dust and seal them. Selection of the proper epoxy for the project is important for a successful repair.

Conclusion

There are many materials and methods available for the repair of concrete. The keys to cost effective successful repairs are selection of an appropriate repair strategy, thorough preparation, and quality application. For the Portland cement concrete-based repairs, the construction methods are widely known. For all the epoxies, polymers, and fibers, it is critical to understand the properties of the particular material. Working with an experienced supplier is important in early projects. Once crews are familiar and have had success with a product, staying with that product will improve consistency and quality. All products are not equal or applicable for every application.

For some of the specialty materials such as shotcrete or fiber reinforcing, experienced applicators are essential. The use of experienced contractors or training in-house personnel is necessary for success.

There are new materials and procedures being developed continuously. Many of them will offer great promise. Some will be successful in the railroad environment; others will not. Understanding the processes and its limitation, evaluating prior real world installation, and using trusted suppliers will help ensure success.

The railroad industry has heavier loads and looks for longer life for its structural repairing than many other industries. Being critical but open to new ideas will create opportunities to improve repair methods and decrease the associated costs.

That concludes my presentation. I want to thank the people on my committee, particularly Roy Mick and Bryan Haight and Kurt Baron, who provided some of the slides of the project show. (Applause)

Mr. Carter: Thank you for a challenging report. As a token of our appreciation, I would like to present you with a certificate. Thank you also, Willie, for your help.

For our next committee report, I would like to invite Preston Sargent to make the introduction.

Mr. Sargent: We have John Carrato with Alfred Benesch who is going to make a presentation for us on retaining wall construction and repairs.

RETAINING WALL CONSTRUCTION AND REPAIRS

Chairman:	John L. Carrato, Vice President, Alfred Benesch & Co.
Committee Member:	R.L. Meinzer, Regl. Engr., Contech Construction Products, Inc.
Sponsor:	Willie Benton, Engineer Structures, Norfolk Southern
Special Contributors	Floyd Dimmick, Sr., Dir. Tech. Sales, Thermal-Chem Corporation Steven Sumner, Structural Engineer, Metra Steven Scherer, Vice President, TCDI

INTRODUCTION

I would like to extend special thanks to Floyd Dimmick of Thermal-Chem, Steve Sumner of Metra, and Steven Scherer of TCDI who were not on the committee but were very instrumental in the development of this report.

This report discusses the different types of retaining walls, their advantages and disadvantages, types and causes of distress and concludes with some methods for repair.

TYPES OF RETAINING WALLS

The most common types of retaining walls include masonry, cast-in-place concrete, sheet piling, soldier pile and lagging, mechanically stabilized earth, crib, bin, and landscape block walls.

Masonry

Masonry walls are rarely used anymore. Typically they are constructed for aesthetic reasons. By nature these are gravity-type walls as they are not capable of handling tension.

CAST-IN-PLACE CONCRETE

BRACED SHEET PIKE WALL

Concrete

Concrete walls are differentiated by whether they are reinforced or not. Codes no longer allow unreinforced concrete, but many walls still in service are unreinforced. Cast-in-place concrete walls can further be divided into gravity, semi-gravity, and cantilever. Gravity walls were designed to be massive enough so that the weight of the concrete overcomes the tension caused by horizontal earth pressure. They therefore do not require reinforcing steel.

Most reinforced concrete walls designed for railroads today are of the semi-gravity variety. They have a sloping back face and the base of the wall is at least 1/4 of the height. They have minimal reinforcing.

Cantilever walls are commonly used for highways and are heavily reinforced. They require the least amount of concrete and utilize the weight of backfill on the heel to resist overturning. Concrete walls are either supported by spread footings or piling.

Sheet Pile

Sheet piling can be divided into cantilever and braced walls. Cantilever walls can typically be used to a height of 15 feet depending on how close they are to the tracks. At this height, you must be willing to accept a couple of inches of deflection. Braced walls can extend very high by using multiple levels of braces. Bracing is typically accomplished by use of battered piles, grouted rods, or rods connected to deadmen. Wales are used to distribute the load on the wall.

Additionally, sheet piling can either be hot rolled or cold formed. Unfortunately, the last plant in the United States to produce hot-rolled sheets was closed last spring. Many contractors have sheets in stock but at some time hot-rolled sheets will become hard to obtain.

Care should be taken when using cold-formed sheeting. Even though the section properties are comparable to hot rolled sheeting, there are recent tests that show they are not as strong in shear at the interlocks. Such walls have failed before reaching their calculated strength.

Soldier Pile

Soldier pile and lagging walls may be the most versatile of all. Like sheet piling, they can be either cantilevered or braced. There are several different types in use. The traditional method is to drive steel piles and place timber lagging behind the piles when excavating. A concrete face can then be poured. They look just like a reinforced concrete wall but with less excavation. Another common method is to auger holes and accurately place the piles, filling the hole with concrete. Then either precast concrete panels or steel sheets can be used for lagging. Clip angles welded to the pile are typically used to support the panels. Specially designed precast concrete posts can be used in lieu of steel piles. When required, these walls can be braced in a similar fashion to sheet pile walls.

Mechanically Stabilized Earth

Mechanically stabilized earth walls have been growing in popularity in recent years because of their economy. There are a number of proprietary walls available produced by companies such as Contech, Reinforced Earth, Double Wall, et cetera. These walls can be constructed with a vertical face or stepped back. There are many facing systems available including segmental block, railroad tie, wire basket, cast-in-place concrete, articulated pre-cast concrete panel, and full height pre-cast concrete panel. The walls function as gravity walls by mobilizing the earth behind the wall with straps or grids embedded in the backfill. AREA Committee 8 has prepared a specification which will soon be published.

Crib and Bin Walls

Concrete and timber crib walls are not as common as they used to be. However, metal bin walls have made a resurgence. They are designed as a gravity wall and can be faced with concrete in a number of aesthetically pleasing styles.

Landscape Blocks

Finally, for lower walls the use of the large landscape blocks is becoming popular because of their appearance and ease of installation. Advantages and Disadvantages

Masonry

The only advantage to masonry walls is that they are attractive. They are very expensive and maintenance intensive. For this reason, they are rarely used anymore.

Concrete

The major advantage of cast-in-place concrete walls is durability. Well constructed concrete walls provide a very long service life. Other advantages include a wide variety of appearances that can be obtained with the use of form liners and color dyes. Concrete walls can even be made to look like limestone. Also, most railroads have the capability to construct concrete walls with their own forces. Finally, concrete can be constructed to any shape required to meet the needs of the site.

The major disadvantage to concrete walls is the amount of excavation required for the footing. Temporary sheet piling is often required to support the track during construction. Also, availability of ready mix concrete can be a concern in remote areas. Finally, cast-in-place walls are typically the most expensive to construct.

Sheet Pile

The major advantage to sheet pile walls is that they require the minimum amount of excavation. Other advantages include:

Can be driven in any type of configuration

Can be faced with concrete for aesthetic reasons

SOLDIER PIKE AND LAGGING

Can be used in a marine environment

Can be constructed in a short time frame

As noted earlier, one disadvantage of sheet pile walls will be the availability of hot-rolled sheets. Now that they are no longer produced in the United States, they will be more difficult to obtain. Other disadvantages include the poor shear strength at the interlocks of cold-formed sheets, and the need for a crane, leads, and hammer.

Soldier Pile

The major advantage to soldier pile and lagging walls is economy. They are very expensive to construct. Equipment large enough to auger 18 inch to 24-inch holes and pick up precast concrete panels is all that is required. Similar to sheet piling, this type of wall can be constructed very quickly. By setting piles in augured holes, the vibration from driving is eliminated. This may be the only wall of choice if you are next to a building. Finally, this type of wall requires minimal excavation.

The only disadvantage of soldier pile and lagging walls is that the piles must be set fairly accurately when using precast concrete panels.

Mechanically Stabilized Earth

The major advantage to mechanically stabilized earth is cost. They typically run approximately 60 percent of the cost of cast-in-place concrete and metal bin walls. A second advantage is the many different appearances available.

The major disadvantage is the amount of soil mass that is required behind the wall. Also, when metal strips are used, corrosion is a concern. Special track protection is required, such as a waterproof membrane located a few feet below the top of the embankment sloped to drain away.

Bin Walls

The major advantage of metal bin walls is the ease of installation in difficult or restrictive conditions. They can be constructed quickly without expensive equipment. Because they are a gravity wall, they are strong and stable. They can also accommodate differential settlement. Finally, using concrete panels for the face allows many attractive options.

The major disadvantage is cost. The cost of bin walls is similar to cast-in-place concrete. Another disadvantage is that there isn't much room to compact the soil inside the bin.

Landscape Blocks

The advantage for landscape block walls are aesthetics and ease of construction. Unfortunately, they can only be used for fairly low walls.

TYPES AND CAUSES OF DISTRESS

There are many types of distress experienced by retaining walls. Some of the more common types are: slip failure, sliding, leaning, differential settlement, over-topping, down drag, cracking, spalling, and corrosion.

Slip Failure

Slip failure is a global failure of a slope that probably would occur if the retaining wall was there or not. This type of failure is usually limited to walls with shallow foundations, such as cast-in-place concrete, masonry and bin walls. However, if sheet piles or soldier piles are not driven deep enough, they can fail in this manner also. Advanced structural or geotechnical solutions are required for this situation. Slip failure is usually attributed to poor or changing soil conditions.

Sliding

This type of failure is most common in walls with shallow foundations such as cast-in-place concrete, masonry, and bin walls. Sliding occurs when the lateral load of the earth pressure and surcharge overcomes the downward force on the wall and the coefficient of friction of the soil allowing the wall to slide forward. Sliding is usually attributed to under design or inadequate drainage. Excavation in front of a wall can also cause sliding. Walls should be designed to accommodate a reasonable amount of excavation in front of the footing.

Leaning

Every type of retaining wall can fall victim to leaning. Leaning is caused by under design, earth or live load surcharges in excess of what was anticipated during design or inadequate drainage. Leaning is at best unsightly and at worst will lead to progressive failure. Even properly designed and constructed walls will lean. Walls should be battered to compensate for the leaning.

Differential Settlement

Differential settlement is most common in walls with shallow foundations. Once again, poor soil conditions, under design and inadequate drainage are the typical culprits. The result is separation of joints in masonry walls and cracking in concrete walls.

Over Topping

Over topping of walls is typically caused by multiple grade raises over the years. As mentioned earlier, this additional surcharge on the wall can lead to sliding or leaning failures.

Down Drag

Down drag can be a problem with metal bin walls. If the soil within the bin is not

compacted properly, soil drags down the members and causes unsightly distortion. This does not result in failure.

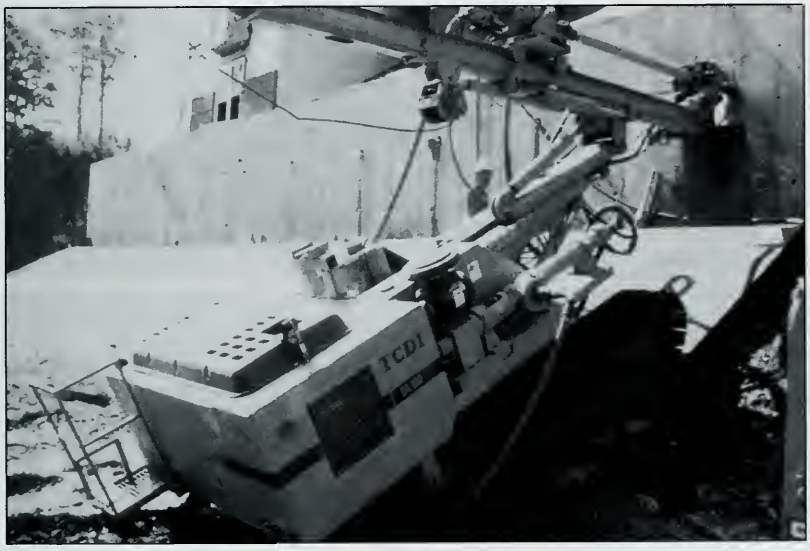
Drainage

A common theme with problems in retaining walls is inadequate drainage. If the soil behind the wall is not free draining, hydrostatic pressure builds up and the load on the wall exceeds what was anticipated in design. This will typically lead to one of the forms of distress noted above.

REPAIR METHODS

Tie Backs

The most common type of repair for walls that are sliding or leaning is to tie them back. This can be done by drilling through the wall and grouting high strength rods into the soil behind the wall or constructing a concrete or sheet pile deadman behind to connect the tie backs. It is essential that the deadman be outside of the slip failure shear plan, otherwise it will move with the wall. Tie backs must also extend into the soil behind the failure surface.



TIE-BACK REPAIR

Counterforts

Other methods for repairing walls that are leaning or sliding include constructing counterforts in front of the wall, placing another wall with an adequate toe right in front of the failing wall or placing a thick concrete slab in front of the wall to act as a kicker.

Pressure Grouting

A different and less frequently used approach to repairing failing walls is to actually repair the soil. One technique is called pressure grouting. Pressure grouting changes the

PRESSURE
GROUT
BULB

EPOXY INJECTION

physical characteristics of soil and rock through the injection of chemical or cementitious grout. This process can increase the load-bearing capacities of the soil and stabilize the structure.

Concrete Repairs

Typical methods of repair for concrete walls include epoxy injection of cracking, mortar patching of spalled areas, formed concrete repair and jacketing of the face. An up and coming material used for patching and formed repair is polymer-based concrete. The benefits of this material include: compatibility with Portland cement concrete, fast setting, can be applied to dry surfaces down to 0 degrees Fahrenheit and moist surfaces down to 33 degrees Fahrenheit, and can be used for shallow, partial depth, and full-depth patching.

Drains

Drainage can be improved by installing vertical drains behind the wall and drilling weep holes through the wall at the vertical drain locations.

Unfortunately, too many times repairs are made to retaining walls without understanding or addressing the cause of the distress. It is essential that we eliminate or mitigate the factors leading to the distress. If a crack is injected with epoxy or pinned with reinforcing steel, but the settlement that caused the crack has not run its course, it will crack again.

Thank you. (Applause)

Mr. Carter: Thank you very much, John. As a token of our appreciation we have a certificate for you.

We are going to take a 10-minute break and they are going to change the cables. Please be back here in ten minutes because we have a couple of presentations left to do. Thank you. (Recess)

Mr. Carter: Steve Ross will introduce our next committee report.

Mr. Ross: Our next topic is confined space. It will be given by Paul Roddy with Conrail.

Paul began his railroad career more than 22 years ago in New Haven, Connecticut, on the Penn Central. On the Penn Central and on Conrail, he has served in various B&B positions in the field in supervisory roles. He was most recently promoted to senior structure inspector at the Conrail headquarters in Philadelphia.

Off the railroad, Paul is nothing less than an ambassador having hosted families for months at a time from Japan and Ireland. Paul has reported directly to the Governor while implementing education programs in the State of Massachusetts.

Among Paul's many roles on Conrail, he is one of only three master trainers in our bridge inspection climbing program. Paul developed, implemented and leads the confined space program on Conrail's B&B department.

Ladies and gentlemen, please welcome Paul Roddy. (Applause)

CONFINED SPACE

Paul Roddy

Senior Structural Inspector
Conrail

Thank you, Steve. It is pleasure to be introduced by a professional who I respect and who is also a good friend.

I was asked to chair a special subject report today on a really deadly topic. I thought about how I was going to make this presentation something that would be interesting and take back with you and be able to utilize back on your properties. The best way I could think to start this presentation is to show you just exactly how deadly this topic really is by showing this video.

When going into a confined space, there is a lot of preparation involved in dealing with how you are going to go in and how you are going to get out safely. These folks are going into a space today that was, believe it or not since you can't hear it, a very noisy circumstance. They have lots of conversation going on. They are not particularly attentive to what it is their specific job duties are as they are going along. It's just a regular day in the neighborhood for them. It's a job they have done 1,000 times. They are very comfortable with it.

But then things change. The space they have been going into on a routine basis happened to be oxygen deficient on this particular day. Of course, a natural reaction that a partner is going to have is to take care of his fellow worker. This is someone they have worked with day in and day out. They are going to panic. They have to save him. It's their buddy. Well, it's a tough time to start thinking about how you are going to rescue somebody out of a hazardous circumstance after that circumstance has presented itself. If you haven't got a plan going into it to know what it is you are going to do, you are going to stop and look around. Where is the phone? How am I going to get some emergency help? A couple of precious seconds have gone by before they have contacted somebody.

One of the real oddities about confined space entrance is the number of deaths involved. Would-be rescuers account for 60 percent of all the deaths simply because of the fact it's their buddy down there. They are going to take care of him. They are going to be the hero. They are going to jump right in and get him out. Unfortunately, that individual just put himself in the exact same disastrous circumstance that his partner had been in. Time and time again this happens in emergency situations in confined space.

When you get into an oxygen deficient situation, it's not an apparent hazard. You can't see the hazard. So what do we have? Instead of one man going down, now we have two. Again, a full 60 percent of all the deaths are would-be rescuers.

I am sure you have all heard of Murphy's Law that anything that can be go wrong, will. Well, when you are in a confined space, Murphy's Law is far too optimistic. **Fact:** If you are seriously injured while in a confined space, you have a 25 percent chance of dying. That's a one in four chance. You have better odds playing Russian roulette.

The film we just watched is a little graphic and a lot less effective because it didn't have the audio. But if there is one thing that I can get you to remember from this presentation it's that we can't be complacent about the hazards of confined space permit entry. The film would have shown more clearly had you had the audio that once you get into a problem and things start to snowball, they just go down hill. One thing for sure that you can count on is that there is a killer out there on the property. It's lurking in a confined space.

This report is Confined Space 101. It's just the bare-bone basics. I must thank the committee members for helping me to compile this presentation. There is a book available and it's outside on the table that I would suggest you pick up. It's really the meat and potatoes of

confined space permit entry. I hope you will make good use of it when you get back home. I am personally quite proud of it. I think you will find it to be a handy reference piece when you are working in and about confined spaces.

OSHA Confined Space Regulations came into effect on April 15, 1993. A full 1.6 million Americans work in confined spaces every year. Until these regulations were developed, many of these men and women who entered into these black holes were only brought out injured, maimed, or dead. These people were working in spaces like gasoline tanks, or industrial cyclones, or pits, or sewers, all of which are very different work environments with a variety of different hazards.

So what is a confined space? A confined space is a place that you can physically enter AND has limited means of entry and exit AND is not designated for continuous occupancy. The key word is AND. You need all three of those conditions before a space is going to be considered a confined space.

The railroad, as an industrial site, has many locations which would meet these standards, many of which B&B employees, in particular, will work in at one time or another.

This manhole is the entrance to a vertical-access sewer being located in the middle of a street and will immediately pose a danger to the entrant just while opening the cover — never mind once inside the confined space.

This hopper car would be a considered a confined space.

So would this engine house pit. It clearly meets all three criteria of a confined space.

The hoppers at the top of the sand tower facility meet the bill, too. It will also present an engulfment hazard, but I will talk about that later on.

This lift station pit also makes the list.

So does this cross cap with end access.

This meter pit is a confined space.

So is this pipe chase.

This scale house does not meet a confined space standard, but the pit below does.

I have a pop quiz for you. Raise your hand if you don't think this is a confined space? Every one of you who raised your hands was right. You have obviously been listening. If you didn't raise your hand, well, we will forgive you.

I use this photo not just to get a laugh but as a way to help you remember that a space must possess all three of the defining criteria before being considered to be a confined space. To be a confined space you must be able to enter it, and have limited access, and it not be designated for continuous occupancy. The general rule of thumb will be that if it has a regular unobstructed door, then it is not a confined space.

Even some of the spaces that meet the criteria will not need any further special handling. They will be known as nonpermit confined spaces. They may be spaces such as culverts which are open at both ends and not of any significant length. Other spaces will need to be entered only after an entry permit has been developed for that specific site.

Vertically accessed spaces and fuel storage tanks are typical of the spaces that may present immediate hazards to life and health and will require an entry permit. Permits will be required when a confined space is also found to contain any of the following conditions:

1. Contains or has the potential to contain a hazardous atmosphere whether from a toxic substance, fumes, or simply from a lack of oxygen, or
2. There is a potential to be engulfed or asphyxiated or drowned in liquid or other fine grain material, or
3. If trapping configurations exist such as a sloped floor or tapering wall that would lead an entrant into a more restricted space, or
4. Any other serious hazard.

Any confined space that has one of these conditions would result in a need for a permit to be issued prior to entry into the space.

Vertically accessed pits can hold oxygen deficient atmospheres and once in them, emergency exit will be difficult especially if there is no escape plan in place before entry. How deep is the water? Is it deep enough to drown in? Even a simple culvert would be a killing zone if an entrant were to become wedged in the more restrictive pipe extension.

Industries are required to evaluate all confined spaces within their physical plan and where permit-required conditions exist, warning signs must be posted at the entry and the entry blocked wherever possible.

As you can see, this manhole has a warning sign posted and has a locked security bar across the top. This is a relatively new product on the market. It's a warning sign that will fit below a manhole cover and can be used in locations where erecting a sign would not be practical.

This is another typical sign that is readily available. It is a non-permit entry sign and, although not required by the regulations, would serve as a notice the space had been surveyed and found not to contain any serious hazards.

This is an example of a permit entry form. In many ways it is similar to a track usage type of document which also includes a formalized job briefing. Its purpose is to ensure the required safety measures for a given particular space are provided for. An example of a permit form is in the reference manual I had mentioned earlier. Under these regulations, industries must identify permit required spaces, establish safety procedures for entering these permitted spaces, provide any required special equipment, and most important of all, must provide training for safe entry, working in, and exit from these permit spaces.

All of these various hazards which might exist in a confined space must first be identified. Employees will need to be trained to identify some of the less obvious dangers. In spaces where there is a potential for hazardous atmosphere, there must be air testing done prior to entry. Samples should be taken from near the floor, near the roof level, and at elevations of not less than four feet in between.

Mechanical crushing hazards must be evaluated. The tines of this auger would rip a man apart with one simple revolution. Pipelines in a pit may be under pressure and could rupture. If you are in a small pit, you will certainly be in harm's way.

Some places will require a contortionist to get in and out of which could make an emergency evacuation extremely difficult. Sand, grain, and sawdust types of materials can result in an engulfment hazard. The material can solidify and create a shell or a bridge while the material below it drains away. If an entrant happens to be standing on top of the shell when it breaks, he runs the risk of being engulfed in the material and asphyxiated by either respiratory ingestion or by simple compression of the chest. Either way, the results are the same.

Before entering this permit-required confined space, the entrant must be provided with the right equipment for the job, the right training, and armed with the knowledge to be able to follow established procedures that will bring him safely out of that space.

This is a list of some of the required special equipment that would be needed for entering a permitted space. It's far from a complete listing. The space itself and the hazards present will dictate the equipment needed for any given location. Air test monitoring equipment will be on the absolute, must have list. Ventilation equipment will also be required. More than half of all confined fatalities are the result of asphyxiation. There are various fans for different applications. Some will flood a space with air being blown in. Others will exhaust toxic fumes from a space and many are capable of doing both such as this unit.

Rescue equipment like this tripod and hoist are perfect for vertical access sites. Some gear has been around for years and is very low tech like the old standby lockout/tagout which will prevent crushing injuries while working in and around these draw bridge drive gears. One padlock and tag could prevent this. Imagine your ankle this badly broken and having to be brought out of a confined space without first having a plan in place as to how that was going to happen.

Training, as I said earlier in my opinion is the most important aspect of these regulations. No matter how many new tools we buy or how good the gadgets are, if they are not used correctly or if the entrant doesn't recognize the hazard, we will only have created a false sense of security. Entrants will need to learn how to use some of these new tools such as this remote air test monitor. Site management skills must be developed.

Only after thorough training that will ensure the safety of the entrant can work begin. The entrant and attendant must work together as a team. If something goes wrong, the entrant's very life will be in the hands of his attendant. Only when these skills and tools are brought together will safe entry, safe work, and safe exit be assured.

One of the permit issues that must be addressed is what do we do in an emergency? If something goes wrong, the last thing you want to do is to have to start looking for a phone. You need a plan in place before permit entry starts. The regulations call for either an in-house rescue team to be in place or a public rescue company can be used in an emergency. If an outside agency is listed on the permit entry, they must be notified and it should be established that they are properly equipped and trained to perform the rescue needed should the need arise. They must be given access to the site for inspection and hands-on training if they desire.

As I said when I started, this is just the bare-bones overview of a permit space entry program. There are very many special applications that are going to be site specific. You are really not going to be able to draw up a generic plan that is going to be a standard plan that you are going to be able to pull out of the bag.

For those of you who are Web cruisers, I would strongly suggest that you jot down this Web address: www.osha.go. You can link through to the confined find space advisor and pick up a software program that utilizes a very simple, point and click, yes and no type of format that would help you in site evaluation. It's really a tremendous little program that I found to be really useful. It's actually less complicated to use than your basic money machine at the bank.

In closing, let me just remind you that if you think OSHA is a small town in Wisconsin, you are in big, big trouble. (Laughter)

In addition to exposing employees to injuries, failure to comply with these regulations may result in some very costly citations. Please do pick up a copy of the manual that we have compiled for confined space entry. Not only is it a tremendous resource, I believe, but with having the ARBBA logo on the front of it, I am sure it's bound to be collector's item now.

Thank you and enjoy the rest of the conference. (Applause)

Mr. Carter: I would like to thank all of the presenters. I know it's difficult enough to put your presentations on with perfect conditions, but your patience with the problems we have been having here today are greatly appreciated.

Our next presenter will be introduced by Dave Franz.

Mr. Franz: I would like to add my thanks, Paul. That was an outstanding presentation.

Our next speaker will be Pat Porzillo. Pat got his Bachelor of Science degree in civil engineering from Georgia Tech University in 1986. He is also a licensed professional engineer. He started his railroad career with Norfolk Southern in the management training program in Knoxville, Tennessee, in 1986. From 1987 to 1993 after going through his management training, he served as a track supervisor. Then from 1993 to 1995, he served as B&B supervisor headquartered in Roanoke, Virginia. In 1996, Pat took his current position as assistant division engineer track and structures for Amtrak in Washington, D.C.

Please join me in welcoming Pat Porzillo. (Applause)

CONCRETE BALLAST DECK BRIDGE ON WHITE CLAY CREEK

Pat Porzillo

Assistant Division Engineer Track and Structures
Amtrak

I would like to start by thanking Joe Lileikis and Steve Dietrich. Steve is my B&B supervisor at Perryville, Maryland, on the territory where we did this bridge project. Joe Lileikis gave me technical support in not only creating the presentation but also procuring the materials and technical advice during the bridge project.

The bridge project is White Clay Creek track one deck replacement. It's located at milepost 32.72 in the northeast corridor. We call it White Clay Creek. It is about five miles south of Wilmington, Delaware.

The existing structure is four 65-foot deck plate girders. It is 110 mile an hour track territory with triple mainline track. About 22 million tons of freight run over this track as well as 20 million tons of passenger service.

Some of the parameters we had to work within is that we had to keep existing tracks one and two live during our construction period with the trains not even subject to speed restrictions running through our adjacent tracks at 110 miles an hour. It's also electrified territory. We had the power turned off on track one where we were doing the deck slide replacement, but on track two the cantinary wire was live carrying 12,000 volts of alternating current and located only 21 feet above the track.

Another major concern we had was we were over a waterway that was used for a feeder for United Water of Delaware. This created more than one problem, but we had special concerns of keeping the water clean and not fouling it. The other concern we had was access to our site. We had been using their right-of-way access road to get to our bridge for inspections for 100 years. However, they wanted to run a pipeline through our right-of-way and they denied our access up until the day of the project.

This depicts our contractual battles with them. However, before we let them do this, we decided to put in a crossing. The interesting thing is Amtrak has no road crossings at all between Washington, D.C., and New York. We put in a 16-foot temporary road crossing and a very strong barricade to protect ourselves and the public. That was a major concern. We kept our project on schedule, ready to go, and lo and behold on the last day, we didn't need to use it.

I will now give a little bit of history about the bridge. It was constructed in 1913 for number one track only. In the 1920s, they poured a cast-in-place concrete deck. That's what we had until our inspection in 1995 identified it as needing replacement. We put it on our 1996 capital program and that's where we sit.

Our estimate for the replacement of the bridge is half a million dollars for the concrete deck replacement. That included electric traction work, signaling, building the slabs, as well as all the track work involved. In the planning stage, we determined our needs and the quantity of set 45 and leveling bars. We leveled the steel over the cover plates of the bridge with the leveling bars, filled the voids with grout, and rebuilt the back walls with set 45.

At Amtrak, it's very difficult to get a track outage like it probably is on most major freight railroads. However, we were looking for a 12-day outage which was difficult. Not only was it difficult for Amtrak, but we had to negotiate with Conrail for them to move their freights on a branchline rather than go through ours. The only other alternative we had to Conrail moving the freight would have been to raise the cantinary wires to allow their vertical clearance on track two. We had an estimate to do this at a cost of $80,000. So there was substantial savings with that.

I put this photo here because that's our supervisor Steve Dietrich with Gary Borden reviewing the plans just to show that in order for this project to be successful, it took a lot of planning.

On April 24, 1996, we began fabricating the pre-cast slabs. It took 11 weeks. We did this work ourselves in Wilmington, Delaware. They were also building an I-beam for another bridge. We had 33 pre-cast slabs weighing approximately nine and a half tons each using five and a half tons of steel reinforcing and 160 yards of concrete. The total cost of the fabrication of the slabs was $168,000.

Here we are beginning to remove the track panels. We did this in three sections. We were able to do this during the daylight hours with tracks two and three live with our watchmen out there in place.

As soon as we removed the track, we began to remove the ballast and stocked all material on the north end of the bridge. You can see us getting down to the existing concrete slab.

Here is a temporary ballast retainer that we installed. Initially we didn't expect we needed this, but in order to maintain a standard ballast section on track two and keep from putting a speed restriction out, we had to install this temporary ballast retainer.

This photo depicts our saw cutting contractor. We hired a contractor to do this work. Initially we received some pretty good prices — about $5,000 dollars to saw cut this slab into sections we could handle at about eight tons a piece. However, by the time we got through with procurement, got the lawyers involved, gave them our requirements along with our insurance requirements, our actual price got to be just shy of $20,000.

We had rain delays one day, but otherwise on the second day the saw cutting proceeded as planned and went really well. From past experience we knew to take extreme care not to cut the cover plates on the bridge.

Because of the radius of the saw blades, we had to come in and break loose the corners around the delicate cover plate area. Also we were very careful not to saw cut into the slabs on track two.

This was Jerry Herndon's idea. He is assistant division engineer track force at Perryville, Maryland. We were in a situation where we planned on removing these with our multi-crane or our Pettibone. In order to do that, we had to do it at night where we could get a track outage without the Amtrak trains being delayed. We were just barely able to handle this with a front-end loader and a crane just to break them loose occasionally. We were able to do this without fouling the other tracks and we were able to do this during daylight continuing our work onto 16-hour shifts at substantial cost savings. It really saved the project and kept us on schedule.

Here we are removing a small piece with a multi-crane. That's how we initially broke them loose. One of our bridge inspectors designed these lifting loads which worked out really well for us. It kept us from having to drill through and putting some on the bottom laterals to secure the slabs.

This photo depicts our fall protection as we installed it. The bridge was approximately 12 feet over the water. We were in a very borderline situation. It was tidal water, and we opted to put some fall protection in place.

Here are the leveling bars. This is something I haven't seen done this way until I came to Amtrak, but on top of the cover plates we welded leveling bars at varying thicknesses and had spacer blocks in between. When we are done with this, we apply grout and it gives us a nice uniform level surface on which to apply a neoprene pad and then the precast slabs.

This shows it complete with the grout and fall protection in place.

Here you can see the neoprene pads down and we are starting to set the precast slabs in place. This activity had to be done at night. We did this using a work train on the adjacent track two.

Here we are actually setting the deck slabs. This photo in particular shows the keyway areas which had to be filled with grout and reinforcing steel to make it a continuous slab.

Here they are set in place getting ready for us to power the keyways. After we put the reinforcing steel in the keyways, we pour the keyways full. It takes about one-third yard for each keyway.

This shows waterproofing being installed. Here we are with the new handrail that we put in. It was galvanized steel. The pipe was prefabricated ahead of time for the handrails. I was particularly impressed with the quality of the job because each piece had to be exactly right and they all fit. It was very low tolerance.

After we had the track in, we laid continuous welded rail across within the same outage.

This is a look at the track just being ready to be surfaced.

That's a look at the finished product completed in 11 days and we were right on budget. We completed the project and the cleanup within just a couple of weeks.

That's all I have. I appreciate your attention. (Applause)

Mr. Carter: Thank you very much, Pat, for an excellent presentation.

Our next speaker is Charles Yordy, who is director of structures programs for Conrail. His presentation today will deal with Conrail's experience in rehabilitation of two of its vertical lift bridges.

Charles joined Conrail in 1977 as assistant B&B supervisor and has worked in all levels of bridge engineering with the B&B department. He is a graduate of Penn State University and a registered professional engineer.

Charles has been a member of the B&B and AREA since 1978 and is also a member of AREA Committee 15.

Please welcome Charles Yordy. (Applause)

COUNTERWEIGHT SHEAVE, TRUNNION, AND ROPE REPLACEMENT ON JERSEY CITY BRIDGE

Charles Yordy

Director of Structures Programs
Conrail

I would like to thank Abbas Pourbohloul, William Linaberry and Martin Nonnenberg for their help in putting this report together.

This afternoon I am going to be talk about movable bridges. My presentation involves the replacement of counterweight, ropes, and sheave assemblies on two of Conrail's vertical lift bridges. This project cost over $4 million. In particular, I am going to discuss the planning and construction of the project, some problems that we encountered, and things to consider if you are involved in a similar project.

At the conclusion of the slide presentation, we have a short five-minute video which has audio track and shows the procedures involved in handling the sheaves of the ropes.

INTRODUCTION

This is the story of two of Conrail's vertical lift bridges, located in close proximity to one another in northern New Jersey. The bridges to be discussed are Bridge No. 4.21 on the Passaic and Harsimus Line spanning the Hackensack River in Jersey City, which is referred to as the "Hack" bridge, and bridge No. 6.75 on the National Docks Line which crosses the upper reaches of Neward Bay, which, for obvious reasons, is known as "Upper Bay."

The scope of the work on both of these bridges involved replacement of counterweight ropes, as well as sheave and trunnion replacement. In the case of the Hack bridge, only one sheave assembly was replaced. For Upper Bay, all sheave assemblies (a total of eight) were replaced.

ROPE INSPECTION

The beginning of this project dates back to August of 1992 when the counterweight ropes were inspected for wear on both bridges. The Hack bridge is a 199-foot long, two track, through-truss lift span weighing 1,115 tons. It has 48 counterweight ropes in eight sets of six each, traveling over sheaves which are 12 feet six inches in diameter. The counterweights at either end of the bridge weigh 550 tons each. Built in 1929 for the Pennsylvania Railroad, the counterweight ropes were last replaced in 1949.

The ropes themselves are 1 - 7/8 inches in diameter of improved plow steel in a 6 x 25 wire configuration around a sisal fiber core. The total lengths of these ropes ranged from 208 feet to 210 feet from center to center of connecting pins.

The rope inspection was limited to those areas considered most likely to exhibit wear and wire breakage; these areas are the tangential contact area to the sheave and at the terminations.

The rope inspection revealed both heavy crown wear in addition to multiple wire breakage in both crown and valley. As many as 13 wire breaks were observed in one rope lay, with six broken wires in one strand being the highest number counted.

Most of the breaks can be attributed to fatigue. Those breaks located in the worn "ovals" were due both to the flexing of the wires as they worked over the sheaves, as well as the metal loss due to abrasion.

The "valley" breaks are related to the direct loss of core support. The fiber core, being vegetable matter, had dried out over time, becoming brittle with consequent loss of resistance to crushing. Damage by crushing prevents the wires, strands, and core from moving and adjusting normally in operation over the sheave.

Bridge 6.75 National Docks Secondary

Inspection of the attachment points revealed wire breaks in unworn sections above the counterweight attachments, most likely from torsional stresses.

In addition to the rope inspection, the grooves on the sheaves were inspected and found to be worn below the minimum allowable contour for worn sheaves. No wear corrugations or deformations were present, but indications of scrubbing were evident due to suspected slippage between the ropes and the sheaves.

The groove wear ranged from an average of 0.0156 inches to a maximum of 0.0781 inches. This amount of wear is not uncommon for 60-plus years of operation, and is directly related to the reduction of rope diameter.

In the final analysis, it was recommended that to ensure continued serviceability that the counterweight ropes be replaced. There was also a recommendation to re-groove the sheaves in conjunction with the rope replacement.

SHEAVE INSPECTION

In developing the counterweight rope replacement as a project, it was evident that the most economical approach would be to combine both Hack and Upper Bay into one project to take advantage of economies of scale, material quantities, and mobilization.

The Upper Bay bridge is a 323 foot long, two track, through-truss lift span weighing 1,800 tons. It has 64 counterweight ropes in eight sets of eight each which travel over 15 foot diameter sheaves. The counterweights at either end of the bridge each weigh 900 tons. Built in 1929 for the Lehigh Valley and Pennsylvania Railroad, the counterweight ropes were last replaced in 1944.

The ropes on this bridge are 2 1/4 inch in diameter of improved plow steel in a 6 x 25 wire configuration around a sisal fiber core. The total lengths of these ropes ranged from 189 feet to 196 feet from center to center of connecting pins.

In October, 1994, a comprehensive inspection of the sheaves at Upper Bay was conducted to determine whether groove wear and other deficiencies documented in the sheave inspection for the Hack bridge would be found on this bridge also. Counterweight rope conditions on Upper Bay were already known to be substantially the same as the conditions previously found at Hack.

The sheave grooves were found to be worn similarly to those on Hack. This wear was also attributed to rope slippage. The wear resulted in different pitch diameters for each rope, which

Ultrasonic testing of trunnion.

Installation of new sheave

in turn, caused uneven loading. The variation in pitch diameters caused certain ropes to slip as the sheave rotates, which aggravated the problem of rope and sheave groove wear.

Recommendation in this case was to machine the sheave grooves to a consistent dimension when new counterweight ropes were installed on the bridge.

FATIGUE ANALYSIS

The Illinois Department of Transportation sponsored an investigation and report of trunnion failures involving vertical lift bridges. This report was issued in June 1980 and contained very useful information regarding a fractured trunnion in a vertical lift bridge built in the 1930s.

According to the report, "The failure was induced by propagated fatigue cracking which became critical after about 600,000 cycles of complete stress reversal. The major contributing factor initiating the failure was the development of high concentrated stresses in a critical fillet area resulting from an abrupt change in section in the configuration of the trunnion."

The diameter of the trunnion at the hub of the sheave is greater than its diameter at the trunnion bearing. The stress concentration factor in a stepped shaft is a function of the ratio of these two diameters and the ratio of the radius of the fillet and the smaller diameter. Experimentally determined curves of these stress concentration factors can be used to develop a predictive model of failure and estimated remaining fatigue life.

In July 1995 we decided to conduct a fatigue analysis of the trunnions to determine if we had any other issues to contend with besides that of the counterweight ropes themselves.

Barge crane on the Hackensack River

Trunnion dimensions were obtained from our plan file. Rope pitch diameter and lift height determined the number of cycles of complete stress reversal for the trunnions per lift. An arbitrary ten bridge lifts per day was chosen for the fatigue analysis for the two bridges in question. Results indicated that before proceeding with the counterweight rope project, the trunnions should be inspected for cracks.

TRUNNION INSPECTION

In September 1995, non-destructive testing of all trunnions on both vertical lift bridges was conducted. In all cases, Magnetic Particle Examination was performed 360 degrees around each shaft in the radius area. In those instances where cracks were detected, Ultrasonic Angle Beam Examination using 45 degree and 70 degree transducers was conducted to approximate the depth of the crack. Also, Straight Beam Examination was done from both ends of the trunnion but did not provide a reflector from the cracked areas.

On the Hack Bridge, only one trunnion of the eight was discovered to be cracked. These trunnions had a 17 1/2 inch diameter at the hub and a 16 inch diameter at the journal bearing area. The radius of the fillet in the shoulder area was 7/16 of an inch. The cracks ranged from continuous to intermittent around 360 degrees of the shaft with a maximum depth of 1 5/16th of an inch.

The following statistics will provide a better picture of the frequency of loading and stress reversals which was the source of fatigue damage to the trunnions.

In 1994, the average number of openings of the Hack bridge was 61 per month except for the month of December when there were no openings. The Upper Bay bridge had approximately 50 percent more openings than the Hack bridge during the same period, averaging 96 openings per month. The average number of openings rose to 152 per month during the first five months of 1995.

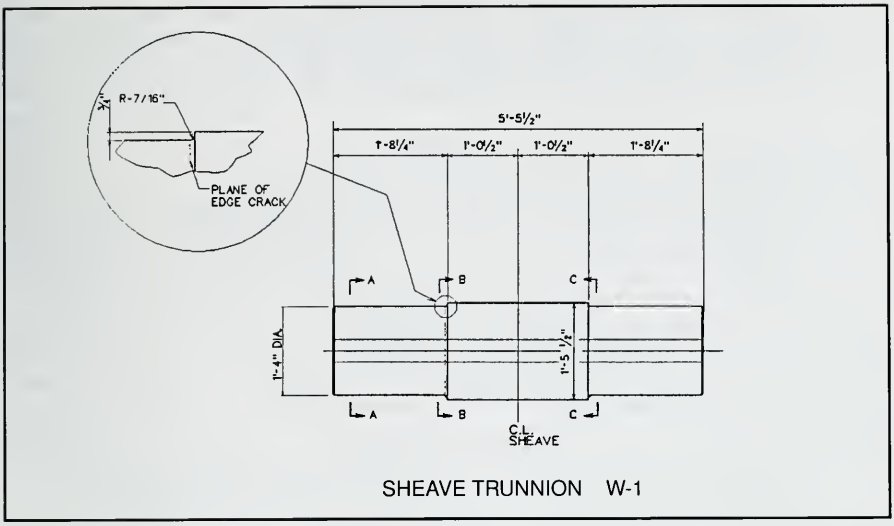


Fig. 1: Trunnion Elevation and Detail at the Hub

A decision had to be made with regard to proper treatment of the discovered cracks. In order to evaluate the seriousness of the fault, a fracture analysis of the crack had to be rendered. Due to lack of basic data required for such analysis, an estimate of the critical stress intensity factor, K_{Ci} as used in performing the analysis. The estimation was based on approximate correlation between the shaft's forged steel and steels having similar metallurgical properties and was assumed to be 45 ksi$\sqrt{in}$.

Our preliminary analysis indicated that 30,000 cycles of stress reversals would be required in order to extend the circumferential edge crack to its unstable (critical) depth. Based on the above statistics, this number of cycles translated into a remaining life of three to five years. We also sought expert opinions in the field of fatigue and fracture of structures. We consulted with Professor John W. Fisher from Lehigh University regarding the condition of the shafts. In his correspondence, Dr. Fisher confirmed our findings regarding the failure of the trunnions had they not been repaired quickly (assuming 18,000 cycle/year operation). He also recommended shot peening of the fillet area of the new shafts. We also refined trunnion detail in the stepped area by providing a larger radius for the fillet in order to reduce the stress concentration factor, k_t and hence the fatigue strength of the trunnions.

Considering the fact that quite a few movable bridges of similar vintage are still in service, data regarding the mechanical properties of the shafts, especially fracture toughness properties, will be of great value to engineers who are responsible for the maintenance of such bridges. Therefore, after the project was completed, we had one of the shafts shipped to a material testing laboratory in order to determine some of the mechanical properties of the forged shaft and also to measure the actual crack depth for comparison with crack depths approximated via non-destructive (ultrasonic) inspection methods.

One of the trunnions removed from the Upper Bay bridge had exhibited the deepest crack and was selected for material testing. Four types of tests were conducted on Shaft W-1 by an outside testing laboratory: Tensile Coupon Test, Brinnel Hardness Test, Charpy V-Notch Test, and Chemical Composition Test. The test results are shown in Tables 1 through 4.

Table 1 - Tensile Coupon Tests

Specimen No.	Original Area	Load at Yield	Max. Load	Stress at Yield	Tensile Strength	Elongation	Reduction of Area
	(in2)	(kips)	(kips)	(ksi)	(ksi)	(%)	(%)
T1	0.1971	8.60	16.95	43.60	86.00	20.5	39.0
T2	0.1979	9.15	18.04	46.20	91.20	18.5	35.0
T3	0.1917	8.70	16.55	45.40	86.30	20.0	41.0

Table 2 - Charpy V-Notch Impact Tests

Specimen No.	Test Temperature (°F)								
	-20	+32	+70	+100	+126	+150	+160	+186	+210
TT1	2	3	9	10	15	15	19	22	25
TT2	3	2	5	10	14	15	18	21	24
TT3	2	4	7	10	15	16	18	23	25

Table 3 - Brinell Hardness Tests

Along the Longitudinal Axis of Trunnion (approximately 1/2" below surface of the journal bearing area)				
162	165	167	171	174

Table 4 - Chemical Composition

Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum
0.47%	0.57%	0.04%	0.044%	0.21%	0.026%	0.065%	0.003%

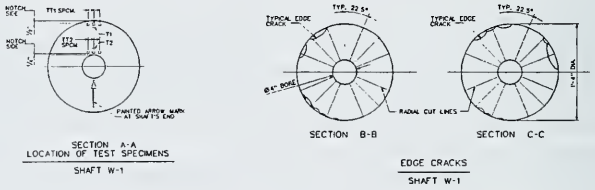


Fig. 2: Trunnion Cross Section Showing Location of Test Specimens and Fatigue Cracks

Using the information obtained from the metallurgical testing and refining the fatigue analysis, the conclusion reached is that by progressing this major work when we did, we averted potentially serious and long-term service interruptions.

DESIGN

As a result of the inspection and testing, a comprehensive scope of work was developed by our staff in Philadelphia. For both lift bridges, it was decided to replace the counterweight ropes. In addition, on the Hack bridge where one of the trunnions was found to be cracked, it was decided to replace the entire sheave assembly. At Upper Bay, we considered replacing the trunnions only but decided against it due to the time required for the bridge to be out of service for ship navigation. Instead, all eight sheave assemblies were slated for replacement.

Having reviewed similar projects conducted by other railroads in the past in which counterweight ropes had been replaced, it was decided to forego machining or regrooving the seven remaining sheaves at Hack.

At the beginning, we briefly considered a design/build project in which the entire

operation would be handled by contract services. However, the long lead time for most of the items, especially sheaves, would have prolonged the project unduly. Furthermore, our designers were confident that they could produce material specifications on a timely basis and we believed that greater control over the project could be maintained if Conrail handled the requisition of all materials.

Of course, the wire rope specifications were relatively straight forward with the main consideration being the type of socket to use for the connections to the bridge and the counterweight. The options were to use an "off the shelf" pin and socket assembly or to have custom-made sockets to match the existing connectors on the bridge and counterweight. We opted for custom made forged sockets to conform with the existing attachments. These were to be provided as part of the wire rope contract.

More problematical was the decision to proceed either with a welded sheave fabrication or to use the existing bridge plans to develop a specification for new cast steel sheaves. Conrail's designer made quite a comprehensive survey of suppliers and clients of various fabricators engaged in this type of work. Probably the most notable comment made concerning the steel castings was, "Your first casting may be your last one!" This observation was apparently based on the conclusion that experts in steel casting belonged to a past generation. However, although we're not building pyramids anymore, there is no doubt that we could do so again even though the experts of generations past are long gone.

The main concern we had with the welded fabrication idea was the delay which would be caused by additional design requirements as well as the critical nature of the fabrication inspection process. The controlling factor for the lead time in obtaining the materials needed for both bridges was the sheave assemblies.

From an economy standpoint, the cost of cast-steel sheaves was not much greater than the fabricated ones. As a matter of fact in our preliminary investigation for the cost of two types of sheaves, one fabricator submitted a proposal for cast sheaves that was 25 percent less than his alternate proposal for the fabricated ones. Considering these factors, we made the decision to proceed with cast-steel sheaves based on specifications developed by Conrail designers.

MATERIAL REQUISITION

In October of 1995, we sent our material specifications and requested proposals from suppliers for the various components required. By December, we had bids from various suppliers for the wire rope and sheave assemblies.

The contract for wire rope and associated hardware was awarded for $750,000 with requested delivery beginning at the end of May 1996.

The contract for the sheave trunnion assemblies and associated bushings was awarded for $1.1 million with an original delivery schedule beginning in mid May and continuing through the end of August.

It was decided to progress the work at the Hack bridge first, since this job required only one complete sheave replacement.

CONSTRUCTION CONTRACT

Concurrent with the request for material quotes, a pre-bid meeting on site was held with prospective construction firms in November 1995. Of particular importance to us, in addition to the price, was the proposed scheduling and sequencing of the work for each bridge.

At the east end of Hack, the restrictive space in the back channel and the presence of control wiring spanning between Conrail's bridge and the adjacent PATH passenger lift bridge made it possible to replace the counterweight ropes using a barge crane. This meant that on-track equipment would be required for staging the rope replacement for the east counterweight. Planning ahead for track time would be of paramount importance.

For both bridges, when barge cranes and material barges were located in the channel, and

during the course of the sheave and rope replacement, the channel would necessarily be out of service to ship navigation. This would entail quite extensive outages which had to be approved by the Coast Guard.

We provided a daily analysis of the number of openings for each bridge for the previous 12 months for consideration by the contractors on estimating their proposed channel outages.

In December, we had proposals from four bidders ranging in price from $2 million to $4.7 million. Needless to say, this wide spread made the bid evaluation process a lot easier than if we had four proposals close in price.

CONSTRUCTION PROCEDURE

The construction procedure was quite simple: using eight 200-ton jacks, raise the counterweight and hang it using the hardware in place for this purpose, disconnect and remove the existing ropes and the sheave. After replacing the bronze bushings, install the new sheave, and then install and adjust the new ropes.

CONSTRUCTION SCHEDULE

Our initial contact with the First Coast Guard District which has jurisdiction over the waterways in question, was by telephone and letter in which we provided the Coast Guard with construction plans and requested consideration for two construction alternatives.

Alternative No. 1 called for all cables on each bridge tower to be replaced during a single continuous outage involving two 4-day outages for Hack and two 5-day outages for Upper Bay.

Alternative No. 2 called for each sheave and associated wire ropes to be replaced during a single 34-hour outage for a total of eight outages for each bridge.

This correspondence was followed up in April by a visit to the First Coast Guard District headquarters on Governors Island, New York, to finalize the scheduled outages. In attendance were representatives from Conrail as well as the contractor, who presented details of proposed barge crane replacement in the channels as well as his scheduling alternatives.

Due to the heavy usage of the Newark Bay Channel and time-sensitive ship traffic for large refineries in the area, Alternative No. 1 was dismissed immediately. This left us with working out the details of Alternative No. 2.

The tentative schedule agreed to at this meeting called for eight separate 48-hour outages for Hack to replace 48 counterweight ropes and one sheave assembly. Days slated for this work were Monday/Tuesday and Thursday/Friday with Wednesday and the weekends provided for bridge openings.

For Upper Bay, we requested nine separate 34-hour outages to replace 64 counterweight ropes and eight sheave assemblies which included one additional day for weather delays. The daily pattern would be the same as for the Hack bridge.

Initial start up included mobilization at Hack during the last week of June followed by four weeks of miscellaneous repair and preparation work in advance of the first channel outage starting July 29.

Mobilization at Upper Bay was set to follow at the end of August with the first channel outage scheduled for September 3rd.

The major concern of the Coast Guard was that there would be certain and adequate time windows on either side of the granted channel outages when there would be no failure to provide bridge openings for navigation.

MATERIAL FABRICATION

In order to safeguard this agreed upon construction schedule, it was incumbent upon us to set up a procedure to track the progress of material fabrication since timely delivery of all the associated parts would be critical for the successful completion of the project.

Conrail set up a bi-weekly faxed progress report with the suppliers showing agreed upon due dates for each portion of the fabrication process.

At this point, let me remind you of the comment, "Your first casting may be your last!" In mid April, we received the disconcerting news that a portion of the sand mold for our first casting failed, resulting in a misformed spoke. The fabricator agreed to recast the sheave and other than setting back the delivery schedule to the second week in June for this first sheave, we experienced no further problems.

Without getting into the details, anyone involved with engineering design must realize the amount of coordination and communication required in dealing with fabricators to troubleshoot the problems and addressing the many questions which arise during the course of a project of this magnitude. The designer's work is not complete until the construction is finished and the material is in place.

It must also be obvious that on a job of this size, one should expect the unexpected. By mid June, due to projected delays in shipment of the last sheave for Upper Bay, the contractor revised his start-up schedule at Hack to minimize down time between the two jobs. Mobilization was set back two weeks to accommodate this change.

Additional coordination and communication with Conrail's transportation department, as well as with the Coast Guard, was required to bring everyone up to speed on the new schedule.

PRE-CONSTRUCTION

A pre-construction meeting was held on June 20th to finalize the construction schedule and sequence to establish interim payment procedures with Conrail's project engineer and to review the environmental protection provisions of the Coast Guard permit as well as the FRA's Roadway Worker requirements and Bridge Worker Safety regulations.

CONSTRUCTION - HACK

Nail-biting time started August 19 when the first of the east counterweight ropes were replaced at Hack bridge. This was the only portion of the work on either bridge which required on-track equipment and exclusive track usage due to the inability to use a barge crane in the back channel of the east approach span.

On Monday/Tuesday, half of the north side counterweight ropes were replaced. The bridge was available for openings on Wednesday, then on Thursday/Friday, the remaining North side counterweight ropes were replaced. Everything appeared to be going according to plan.

However, one thing which was overlooked and did not become evident until a bridge opening during the weekend was that, in it original condition, the counterweight was not level by several inches, being low on the north side, before any ropes were replaced.

Everyone familiar with the tendency of new ropes to stretch can envision what happened next. During a lift on Friday night, the bridge went up all right, but on its descent, the counterweight (on its way up) jammed against the counterweight guide rails, preventing the bridge from seating. After torch cutting a section of the counterweight guide out of the way, the bridge was seated and additional adjustments were made to the new ropes.

The following week when new ropes were applied to the south side of the counterweight, the final adjustments were made and the problem resolved.

A check of the west counterweight revealed that it also was several inches low on the north side. But at least now we knew what to expect and what precautions to take to prevent a recurrence.

Of course your last problem is never like the next one. After a one-week delay due to our barge operator's preparation for Hurricane Edward, we geared up to install the counterweight ropes and one sheave at the west end of the bridge. The first problem was getting the barge

crane up the channel and positioned next to the west tower. The close proximity of the adjacent PATH bridge (190 feet between the two bridges at the narrowest point) made this feat somewhat like docking the space shuttle. It required a degree of choreography not normally encountered by crane operators and tug boat captains.

First, the PATH bridge had to be raised to allow the 200-ton barge crane with its 300-foot boom extended horizontally out in front to pass underneath. As the crane cleared the underside of the PATH bridge, the operator had to begin raising the boom to a vertical position so as not to impact the Conrail bridge immediately in front of it. Once in position, the barge was fixed in place by sinking spuds into the channel at its corners.

The crane, now in place, was able to handle the counterweight ropes and the sheave as planned and all went well until it came time to move the barge back out of the channel. During the course of this operation, we had the opportunity to repeat the previous performance in reverse, the big difference being that this time we were operating in the midst of the tail end of Hurricane Fran with wind gusts over 50 miles per hour, something that you don't often see in northern New Jersey.

I am happy and relieved to say that all went well. And it was time to move on to the next bridge.

CONSTRUCTION - UPPER BAY

The advantages of a much larger channel and more space to work in at Upper Bay were offset by the more frequent bridge openings required at this location.

During mobilization at the bridge when the Coast Guard issued its advisory to the shippers, we were blindsided with a last-minute change in plan. One of the larger shippers in the area could not live with a 24-hour window in the middle of the week which we had used successfully at Hack. In fact, they insisted on no less than a 48-hour window between each channel outage. This meant that our schedule had to be drastically altered. In essence, the plan now developed as a series of two-day outages, interspersed with two-day navigation windows for the shippers.

The bottom line was increased costs due to overtime work on several weekends as well as additional equipment expense because the overall schedule was extended.

This abrupt change in schedule was accepted as another one of those unexpected occurrences which couldn't have been planned for and we set to work on October 7th removing ropes and first sheave.

This portion of the project began in perfect weather. The sky was blue, nearly cloudless, and there were no winds to contend with. The following day was an entirely different story. On October 8th, when we installed the eight new counterweight ropes, the weather grew progressively worse until by the end of the day the sky was black and the winds and rain were howling across the Bay horizontally as we made final adjustments to the ropes and performed a test lift of the bridge. The work was accomplished in the midst of Tropical Storm Josephine.

Except for this horrible weather, everything went well. The job progressed into the middle of November, replacing the eight sheaves and 64 counterweight ropes.

CONCLUSION

Some of the most important things to remember going into a project of this size and nature are:

1. not assume that everyone you deal with will be an expert in the work you propose to do. As a matter of fact, the need for so many people involved in the process guarantees that there will be areas in which there is no prior expertise.
2. Be as thorough and meticulous in your planning as possible. This will not eliminate surprises, but it will reduce their number.
3. Accept the fact that you cannot foresee everything that may happen and that sometimes

things will not go according to plan. You have to be flexible in your approach. Have supervision on the ground who can exercise good judgment.

4. Understanding that there will be a learning experience going on during the project, it is very important to start with a team concept. This includes complete and frequent communication between designers, suppliers, contractors, project managers, and supervisors. As a team, you will be better prepared to successfully handle the unexpected when it occurs.

Regarding counterweight ropes and sheave replacement specifically, keep in mind the following:

1. Inventory the hardware necessary to hang the counterweights. Incomplete sets of hardware means moving this equipment from one counterweight to the other and construction schedules have to be arranged accordingly.
2. Keep in mind the peak navigation season and plan construction when you will have the least impact on shippers. This will facilitate coordination with the Coast Guard and eliminate headaches due to last minute changes in plans.
3. Survey the counterweights and place reference marks before any work is started. If the counterweights are out of level, you may want to sequence the work to prevent accentuating this out-of-level condition due to stretching of the new ropes before the final adjustments are made.
4. Also, during the construction, these reference marks should be checked daily to make sure the counterweights will not become jammed in the guides before the final adjustments and leveling are made. A log should be kept showing daily measurements at each reference location.
5. Each day before test lifts are made, you should make a complete check for obstructions which may hinder the bridge opening. This includes checking around all sheaves, counterweight lifting brackets, construction scaffolding, et cetera.
6. Continuously during the course of construction, ensure that there are no obstacles projecting into the clearance envelope for passing trains. This includes chain falls, ropes, electrical cords, and scaffolding.
7. All materials to be installed should be shop assembled and match-marked prior to shipment.

Regarding design issues:

1. It is critical that the new design allows for ample fillet in the shoulder area of the shaft. The large radius in the transition areas between the hub and the journal bearing reduces stress concentration which results in the following benefits
   a. The time required for crack initiation, which comprises the major portion of fatigue life of the component, increases.
   b. The number of cycles to extend a crack to its critical length increases due to the fact that the rate of crack extension per loading cycle is proportional to the local stress intensity factor fluctuation (ΔK_1). The latter is a function of the stress field which drives the crack.
2. Enhance the fatigue life of the shaft by surface treating the critical areas of the shaft as follows a. The shoulder area of the shaft must receive a mirror finish to reduce the number of crack initiation sites. The condition can be preserved by regular maintenance and lubrication (reducing the creation of rough surfaces due to corrosion). b. Apply shot peening with adequate depth of penetration in the fillet area of the shaft shoulders.
3. If a monitoring program is being implemented for a crack shaft, make sure that adequate information is available with regard to material properties since most of the remaining fatigue life of the component in terms of stress cycles is consumed during the initial stages of crack propagation.

Thank you for your attention and I hope to see you at the rest of the conference. (Applause)

Mr. Lileikis: Thank you very much, Charles, for an excellent presentation.

That's going to conclude the B&B session for today. AREA Committee 32 symposium begins at 1:00 p.m. in Room 4300A and admittance is by ticket only. If you did not register for the symposium, you may do so at the registration desk.

Don't forget the REMSA reception tonight at the Westin Hotel beginning at 6:15 p.m. We will reconvene tomorrow morning at 8:00 a.m. in Room 4300E where today's joint session was held.

This session is adjourned. (Applause)

(Adjourn)

JOINT SESSION

Wednesday, September 10, 1997

President Russell: Hopefully everybody enjoyed the reception last night. REMSA has been very hospitable during the last two or three days making sure that we were all taken care of and entertaining us and I would like to give REMSA a big round of applause. Thank you.

(Applause)

I have a couple of items to address now. I would assume that after being here for two or three days, everybody is aware of the safety briefing we have been having. The exit signs are over the doors and everybody knows where the escalators and stairs are to get outside. If you need first aid, that's available at the entrance of the exhibit hall.

Just as information and for those of you who like to keep statistics, in Denver in 1993 we had 1,998 registered members and 505 spouses. This year at this gathering we have exceeded our expectations. We have 2,080 registered members and associates and 270 spouses or significant others. So that tells me that the interest in our maintenance and engineering groups is still alive and well and growing in spite of the fact that we continue to see our properties shrink. We are, however, growing in other places. So I commend everyone for supporting this event and coming to these conferences. I know it takes out of your time, but they are very enjoyable and very informative. That's what we are here for — to continue an education.

I have one other item of interest. Anybody who is going to attend the proposed AREMA board meeting which will follow this session this morning, it will be held in Room 4202A.

The other thing is the exhibits, of course, are still open this morning. If you have time and you want to visit them, feel free to go out and take a look at things. I believe they are shutting down at noon.

What we want to do is continue to pick up the survey forms. Again, these are very important. We want to pass these on to the AREMA board to determine what you people want to see in the programs. These forms give us an idea of what we should be putting on in the future. So please either give them to any of the directors or leave them on the tables at the rear. Thank you.

I will now ask Andy Sensing to introduce our first presentation.

Once again, thank you for your participation in this conference and I hope you have a good, safe trip home if I don't get to see you before you leave.

Mr. Sensing: Good morning. First, let's start off with an apology. Our technicians were unable to work out the video conversions so we are going to have blurry pictures. However, we have an excellent visual presentation and Bill and Mike have done a lot of work to put it together. It is, therefore, unfortunate that it has to come off like this. If you come up to the monitor, though, it looks great.

Let's get started. Our first presentation this morning is Coping with Winter Challenges. The presenters are Bill Ross, track maintenance supervisor, Canadian Pacific, and Mike Nuorala, division engineer, Burlington Northern Santa Fe.

Bill started with the Canadian Pacific Railway in 1974 and worked in various supervisory positions including branch line roadmaster on the Prairies in Stettler, Alberta. He served as roadmaster of Edmonton Terminals in northern Alberta and Golden in British Columbia which includes the Kicking Horse Canyon and Rogers Pass.

Bill presently works as track maintenance supervisor in Kamloops, British Columbia, however, this Monday he begins a new assignment as train development specialist. Bill is also a director of the Roadmasters Association. Please welcome Bill Ross. (Applause)

COPING WITH WINTER CHALLENGES

Bill Ross
Track Maintenance Supervisor
Canadian Pacific

Mike Nuorala
Division Engineer
BNSF

Mr. Ross: Thank you, Andy. It's a shame I didn't bring 3-D glasses for everyone. (Laughter) Good morning, ladies and gentlemen. After the winter that we have just experienced last year in parts of the Midwest, Pacific Northwest, and in Canada, it seems appropriate to have a discussion on winter and some of the challenges that railroaders are faced with in dealing with winter in the north.

While I do not want to promote the stereotype of Canada and that we are covered in a blanket of snow nearly all year, I do want to impress upon you that long, cold winters are an additional burden that our neighbors to the south are lucky enough not to have to endure — at least not to the same extent that we do in Canada and in the northern United States.

For the record, I have never eaten whale, nor have I ever slept in an igloo, but I have been out on the Prairies where the wind chill factor, that is the combination of wind and temperature, is minus 75 degrees Celsius. In Fahrenheit, that's minus 100. Either way you put it, that's extremely cold. I have also been the roadmaster on Rogers Pass where the annual snowfall was about forty feet. These, of course, are extremes.

Our railroads in North America encounter many diverse landscapes and climates. Each region creates its own individual challenges. There are the Prairies where the flatlands leave structures and infrastructures exposed to the harsh winds and temperatures. There are also the mountains and mountain passes. They are beautiful to look at, but not so great to try to operate a railway through. With enormous snowfalls, numerous slope slides, and dangerous avalanches, this can be a railway's greatest challenge.

Then there is just about everything in between. The common thread is that, for the most part, our track forces are dedicated to the removal of ice and snow in dealing with winter-related conditions from the first of November to the end of March.

As most operating manuals and rule books start with a safety rule and the company mission statement on safety, it seems appropriate to first discuss the impact that winter has on safety. There are the obvious injuries and accidents as the result of working, walking, and driving on snow and ice. Many of our personal injuries are categorized as slipping, tripping, and falling and you can well imagine that the majority of these occurrences are during the winter. Tasks that we normally take for granted are more difficult during winter conditions. Driving, for example, jump starting the frozen vehicle in the morning, scraping the windshield, shoveling the driveway, driving to work in the dark before the highway maintenance crews have plowed and sanded the roads, or driving to work during white-out conditions where visibility is nearly zero. This is all before the real work begins.

To work in cold climates, the additional clothes and protective gear create a safety hazard by reducing the ability to see, hear, and feel. Vision is impaired by safety glasses frosting up and hoods of parkas and other head gear act as blinders obscuring the peripheral vision. Parkas, earmuffs, and scarfs muffle noise and the snow on the ground dampens the sound of oncoming trains and equipment which reduces the effectiveness of someone or something warning of an approaching danger.

The bitter cold desensitizes the extremities and restricts the flow of blood to fingers and toes causing numbness and clumsiness, slowing production as well as adding to the risk of injury. Of course, there is always the risk of frostbite to exposed skin.

So now that we've arrived at work and gotten dressed, let's take a look at the work that is involved in managing a railroad in the snow.

In terminals and large yards, a few inches of snow can create havoc. The yard operations need the switches cleaned and working areas plowed and sanded. It is often necessary to split crews and dispatch them to the areas to clean switches on a priority basis. However, to the train crews and the operating people, every switch is a number one priority.

The basic tools are a switch broom and a shovel. They are lightweight and very affordable. The prolonged shoveling and sweeping can be strenuous on our aging workforce. To reduce the risks, we have supplied backpack gas-powered snowblowers to make the work easier. They are portable, but there is still the risk of back strain from carrying the blower all day. They are not very effective in wet or frozen, crusty snow. An air compressor is a very effective way to remove snow on switches and road crossing flangeways. Strong air pressure is fast and takes very little effort from the worker.

The disadvantages of having a compressor with strong enough air pressure also means it's not very portable and must be towed behind or mounted in the back of the truck and cannot easily access many of the switches in a yard unless the truck and compressor are hi-rail. Then there is the issue of track time.

Then there is the snow jet which is a vehicle with a jet engine from a B-52 bomber. There are definite advantages and disadvantages to a snow jet. It quickly melts and dries the crossing and turnout in about five minutes. However, an icing or difficult location may take up to 10 or 15 minutes. It can also travel by highway to remote locations thereby not using up valuable track time. The downside to this is that it is a jet engine off a B-52 bomber making it very loud which does not impress the neighbors. It is also expensive to operate and burns between 250 and 350 gallons of kerosene per hour. The force of the blast tends to blow ballast and debris around making it dangerous to work near.

These are all effective tools for handling snow in the yards, however, another more difficult challenge to track forces is battling snow on the Prairies. The Prairies have long been known for the extremes in weather. The flat land is prone to flooding and erosion in the spring, droughts and pestilents in the summer, and with any luck, a bountiful harvest in the fall. That is if there is no rain or hail. Then there is winter, the other ten months of the year. (Laughter)

Anyone who has stood out on the track in the middle of nowhere in a Prairie blizzard understands what vulnerable means. You've also learned pain, fear, frustration, and gained a profound admiration for the comfort of natural heating. It is not just the cold that's the hardest to deal with, it is the combination of cold and wind — that constant blowing wind that freezes skin in seconds, creates white-out conditions that completely stop highway traffic and cause some of the most horrendous freeway pileups that you have seen on the evening news. It is these same winds that create huge snow drifts. The build up of snow from packed in cuts make the snow drifts extremely hard and difficult to clear. Once clear, they quickly fill in again.

As I said earlier, during the winter months the track forces are virtually dedicated to the removal of snow and ice. The wind undoes everything that the track forces have worked so hard to open up. Switch points plug faster than they can be cleared. During extreme adverse conditions, the track crews will ride with the train that needs to operate switches and clean the switches that are immediately required. You can imagine how this slows down trains and uses up our manpower.

The mountains and mountain passes do not have to contend with the constant strong winds of the Prairies. They have their own unique challenges and are probably the most dramatic.

Rogers Pass, situated in the Rocky Mountains of British Columbia, gets an average of 40 feet of snow per year. The warm, moist air blows up from the Pacific Ocean and cools as it comes inland. As it reaches the mountains, moist air is forced upwards where it freezes, becomes snow, and falls and falls and falls. It is not unusual for snow to fall an inch or two per hour and a foot or two or more per day.

We have track forces that are situated in camps in the Pass so that during the heavy snowfalls when they have closed the highways our crews can continue to work. In Rogers Pass, the risk of avalanche is high all winter long. The TransCanada Highway follows the same route through the Pass as the Canadian Pacific Railway does. The Department of Transport has identified over 100 active avalanche passes over the years and have built snow sheds at the most active slide paths to prevent huge snow slides hitting the highway and rails at speeds of up to 150 miles per hour.

The CPR completed the rail line through the Pass during 1885. They constructed a series of snow sheds and these snow sheds were just not enough. After 62 people were killed by a single avalanche in 1912, CPR began a five mile long tunnel under the most hazardous portion of the Pass. Today as a grade reduction project, there is the nine-mile McDonald Tunnel passing under the still operational five mile long tunnel.

When the highway and railway are not protected by tunnels or snow sheds, the military are on alert to close the highway and the railway and shoot the slides down with artillery fire. During the winter months, all employees working in the avalanche zones are required to check in and out of zones so that they can be instructed to vacate when needed or a search can be initiated if they fail to report themselves clear.

The Department of Transport issues alerts known as yellow and red forms. The yellow form is a warning to stand by and the red is a form to evacuate the area. This includes stopping all trains outside of the danger zone. In addition, all workers are issued beepers to help locate them in case they are buried in an avalanche.

It is a relentless fight to keep the passes open with men and equipment. To win the battle we use all sorts of equipment including rail bound, rubber tired, and cat track. Ballast regulators are converted in the late fall to be self propelled, a combination snow plow, spreader, and snow blower. These 275 horsepower snow fighters cost about $300,000 each and we have over 60 on the system. In the mountains alone, there are 10 to cover 250 miles of track or one machine and two operators for every 25 miles of track. These do an excellent job of maintaining the lighter snowfalls and keeping the switch areas clean. An added benefit is not relying on train crews or locomotive power.

Snow fighters and the operators work relatively long hours or, when necessary, double shift the machine. But when it really snows, we need the workforce of the snow-fighting arsenal. Snow plows do not have many creature comforts, but then you don't want a lot of fragile accessories when there is a locomotive driving a plow into a tree, wind drove, or snow slide. Snow plows have been around a long time and they have proven to be consistently good performers. When all else fails, the snow plow will usually punch through ordinary slides and plow very deep snow.

After the snow plows have cut a swath through the snow, the spreader is used to groom the snow and push it back further to allow the next onslaught. The spreader is normally part of a snowplow consist and is also used in heavy snow regions to spread the yards. Although in the lighter snow regions, the snow fighters can usually handle this kind of work.

In most terminals and areas in the snow belt, there are loader stations to keep roads and parking lots clear as well as removing snowbanks and wind droves. Often the accumulation of snow becomes so great that we have to load the snow into air dumps or trucks and haul it out of the yards.

Bulldozers are usually only used during the heavy snowfalls or during emergency work where large volumes of snow have to be removed.

Backhoes are used to a lesser degree than loaders. They are often a year-round assignment pressed into winter service. Actually when the snow really starts to fall, we will grab just about any piece of equipment we can get our hands on.

Switch heaters are located at each main track switch and some important yard switches in areas of heavy snow. They are remotely controlled by a rail traffic controller when it's

snowing and blowing or when it's difficult to have a switch lined. These propane or kerosene heaters produce 265,000 BTUs and the new generation of switch heaters exceed 400,000 BTUs.

Many of our tunnels have underground springs pouring water onto the track and into the ditches. The free-running water when exposed to the ambient temperature freezes to the rail and plugs the drainage. The constant dripping of water will soon freeze over the rail. It is necessary to have crews chip the ice free of the rail head and flangeway to prevent a derailment. We have corrected a number of these tunnel icing locations by lining the tunnel with polyethylene foam. The free-running water is protected from freezing temperatures and diverted to buried culverts and flows freely out of the tunnel.

Even though I have spoken of Prairie and Mountain regions as they are unique and have separate circumstances, railways in the north have common problems as well. It is usually only the severity and duration of the problems that make the difference.

Highway crews clearing snow will plow over a road crossing filling the flangeways with a mixture of snow, slush, and sand that will freeze. Constant vigilance to road crossing flangeways is important to avoid the flangeways icing over and derailing the trains.

Snow-plugged switches contribute to most of our basic track maintenance force work. During the winter months, frequent snowfalls as low as a few inches will cause crews to be called out. The crew will normally take all day just to get their own territory cleaned up only to arrive the next day to have to start all over again.

Broken rails are the most unpredictable condition. We run an extra rail defect detection car prior to the first cold snap in early winter to remove defects that will almost certainly cause rails to break. Not being able to predict what rail might break and then having to call workers out in the middle of the night often creates serious train delays. We have tried to reduce those train delays by having the track crews respond to all track occupancy indications in the CTC at the same time the signal maintainers are notified. This does result in some false alarms, but does reduce the train delays when it is actually a broken rail. In high suspect locations and on heavy tonnage lines additional night crews may be used to handle an initial response.

When the tensile stress and CWR on bolted rail becomes too great, the bolts that are joined to the bolt bars fail causing the rail ends to fall apart. Albeit not as threatening as a track buckle, it is still time consuming to shovel the snow away from the rail web and base and move the anchors and fire a diesel-soaked rope to heat the rail, close the gap, and restress the rail.

Tie plate icing or ice build up is a condition caused by the contracting rail canting inwards creating a gap between the rail base and the tie plate. That allows blowing snow to be compressed as the train passes. This continuous process creates compression ice that will eventually lift the rail base right out of the tie plate rail seat so the outside spike is the only lateral restraint. This causes sudden wide gauge conditions. Modified tie plates or rolled tie plates with elastic fasteners prevent this troubling situation.

Frost heaving is not much of a problem if the ballast conditions and subgrades are good, but some of the branch lines spend a great deal of their time shimming these out.

All these conditions are easy to see and a track inspector can usually find them as long as it isn't snowing and the track is buried.

When dealing with winter conditions is not enough, the aftermath of winter can be just as devastating. Sudden warm weather or warm spring rains melt the winter snow pack too quickly for the creeks and rivers to handle. The ground is still insulated from the remaining snow and is frozen. It, therefore, cannot absorb the rapid runoff. Flashfloods carry debris, plug culverts, dams and streams resulting in washed-out track. Ground water and water overflowing its banks saturate the subgrade further destabilizing the roadbed.

The constant freeze/thaw cycles cause ice to expand in cracks of rocks bringing down large rock falls from cliffs. In the interior of British Columbia, large river stone are perched high on sandy, clay banks. In the early spring as the frost leaves, exposed rocks are prone to

rolling down onto the track. Our line of defense is to maintain a good rock catchment ditch and establish concrete rock blocks.

Besides all the costs associated with winter conditions, there is also the time lost every year when construction crews cannot work. The equipment for these gangs unless converted to winter service sits idle and the men are laid off or reassigned. The production season is about seven months. This, of course, varies on different regions.

I referred to working during adverse conditions as war. Well, the analogy isn't bad. We use snow fighters to plow snow, Howitzers and bombs to blast avalanches, helicopter surveillance of our slopes and curves, and we immobilize the military to assist in blizzard rescue and flood relief. Allow me to reminisce about the battle of 1997.

It was a bad winter all over, particularly in the Midwest, Pacific Northwest, and Canada. I know Mike Nuorala will speak about the problems in the United States, so I will talk of the winter we had in Canada.

In Canada, last winter was brutal. The combined levels of snow, cold, and wind, made it the second worst winter in recorded history and the worst in over 80 years. On New Year's Day, the news media in British Columbia was talking about the storm of the century. By the end of winter when the Red River rose to unprecedented levels above its flat banks in Minnesota, North Dakota, and Manitoba, the national media dubbed this the flood of the century.

While I can't speak first hand about the flood of the century, I can speak with all too much familiarity of the storm of the century. It started in early November with cold temperatures and much higher than average snowfalls. By December we were under a full-scale assault from winter storms in the Prairies and in British Columbia. Our men were called out to repair broken rails or clean switches nearly every night. The frequent storms delayed trains and increased turn-around times which resulted in loss of traffic.

Grain volumes from the Prairies were the worst, with a net loss of about 30 percent. The storms were so severe and unpredictable that our operations center was managing the railway as if there was a derailment on each of the key corridors each day. It seemed that as soon as all the available people would clear one blockage, we were confronted with another.

In the Province of British Columbia, the Department of Highways reported 1,150 avalanches in a nine-day period between December 28th and January 5th. About the only solution that worked well was the efforts of our people. Without the dedication that our company enjoys, we would never have recovered as quickly as we did. It was a truly valiant effort in all crafts, not only during the winter battle, but with the clean up and catch up that followed. I know I won't surprise anyone in this group when I tell you that the engineering services were really the front line of our winter assault. They worked long, hard hours in poor conditions. Without their dedication and diligence, the winter from hell could have crippled us.

I am, however, happy to say today that we are back on track and meeting our operating objectives. What I'm not happy about is that winter is just a little more than a month away. Thank you. (Applause)

Mr. Nuorala: Good morning everyone. The subject that I'm going to talk about today is not particularly educational and didn't require much research; however, it does have that special sound of natural devastation which seems to intrigue most people — Coping with Winter Challenges.

The last two winters have been the most challenging of my career. The Pacific Northwest has experienced some of its worst winter weather in recorded history. Mother Nature has presented us with a variety of challenges such as rain storms, ice storms, snow storms, earthquakes, mud slides, land slides, and flooding.

At this point in the presentation, I would like to show a brief film which is a variety of video highlights from a local Seattle news station and an amateur photographer. This film should give everyone a good general overview of the magnitude of some of the events which occurred.

For informational purposes, the last couple of minutes of the video are scenes from our two main track routes between Seattle and Everett.

(Whereupon there was a video presentation)

"It started quietly the day after Christmas, but it wouldn't let up. First, a heavy snow. Then the second punch — the storm that paralyzed the Passes, broke the buses, and quickly turned life into disaster. Now, KOMO News 4 looks back at a storm to remember.

Let me give you some statistics on this: Seventeen of 19 structures collapsed out there sinking 270 of 400 boats. The average cost per boat is $300,000.

This is University Village damage. Part of the roof actually caved in here at the center of the mall so security officers closed off that part of the mall.

There is also quite a bit of damage out at Crossroads Mall to the Blockbuster video store. A 30 by 30 chunk of ice fell through the roof and damaged quite a bit of inventory. There is a mobile home park and there are collapsing homes and carports here. Forty carports were damaged when the snow just became too heavy.

This slide we first saw on KOMO News 4 at 9:00 a.m. this morning. I found it hard to believe. It's the first time I have ever seen a snowmobiler in downtown Seattle. It may be only time we see one any time at least in the near future.

Also in Seattle, take a look at this fire truck and watch those spinning tires. He is going to get down to pavement and watch the sparks fly here. Emergency crews really had a tough time even trying to get the buses towed out. We will see what happens tomorrow morning.

Our hard-working photographers caught this out in Redmond. This is one of many carports that collapsed all over the Puget Sound area. There's a lot of damage to cars. Insurance adjusters are going to be very busy.

We have seen some of the other marina collapses. This is one at Newport on Lake Washington and look at all the boats underneath those roofs. It's going to be quite a clean up once they assess the damages there.

We spoke earlier with the president of Drug Emporium and he tells us that the building has been condemned. They can't even get inside to assess the loss on the inventory there, but they know that the building is completely lost. They expect to get inside sometime toward the end of the week.

We were sitting here talking to an owner who saw his boat out there. He decided he must go out and try and cut the line of his boat. You can see it's really treacherous and the boats and the docks are very unstable, but he had to get out there. What he didn't know was he was cutting the line to the only boat, his, that was holding the roof up. Here's what happened the moment he cut that line. 'He's on his boat! He's on his boat! He is on the very bottom! He's okay. He's standing up.'

So some very tense moments there as people wondered if Jim Peterson was okay. As you can see he actually walked away. He actually walked away from the boat. Some very tense moments and people are very stressed at having seen him going down. He was, of course, on the boat. People feared he may not have made it.

When melting snow saturated this hillside, it had a devastating effect. The earth eventually gave way and now a massive mud slide covers all four lanes of Highway 12 outside Aberdeen.

Take a look at Snoqualmie Falls. All that snow melt coupled with the new rain we are getting has turned the famous falls into quite an impressive sight.

Western Washington is reeling from a one/two punch. Now the warm rain is melting the snow and ice of the cold snap. There are broken businesses, floating cars, crushed Mercedes, and the storm disaster is not over yet.

Chehalis and Shookamchuck Rivers are spilling over their banks. They are threatening farms and neighborhoods in and around Chehalis and Centralia. These pictures are just in from Air 4. The two rivers are still rising. Most of the flooding is still confined to farm areas. Several

low-lying neighborhoods are under water as you can see and the flood water is closing in on stretches of Interstate 5. There was a problem in that area before.

Here is what is causing so much trouble around Seattle and other places tonight. Mud sliding down hills slide onto roads and into homes.

Trouble can come from beneath as well. This immense sink hole shows it's just part of the storm disaster that continues to grip western Washington.

There are slides all over. The melting snow breaks the hillsides apart. Here you can see a chunk of earth sliced from the hill. The slide hit homes. No one is hurt. The slides cover the railroad tracks below the bluff. There is mud every where.

You are looking at one of three major developing stories we're following for you right now. This massive mud slide cut off a major transportation route crashing on the railroad tracks and pushing part of a moving train into Puget Sound.

As the massive mud slide is threatening homes and blocking railroad tracks in Woodway just south of Edmonds, Burlington Northern clean up crews say the main line might be closed at least 48 hours. Some think it's going to be a longer job to clear those tracks out with all that on there. The slide washed out 400 feet of tracks and dumped five railroad cars in the Sound. Some of those cars are buried under 40 feet of mud and trees. Fortunately, no one was hurt.

Emergency crews evacuated a convent and about a dozen nuns as well as a second home as a precaution. No homes are in danger of sliding at this point but they are watching it closely.

Burlington Northern has brought in searchlights as crews start to dig out the mess. Freight trains have been re-routed through the Columbia Gorge and Amtrak service between Seattle and Vancouver is shut down.

We have been keeping an eye of the situation all day as you well know. Let's look at what we can see from Chopper 7 right now. As daylight begins to fall here you can see workers in full force. They have a large amount of earth-moving equipment down there. They have track hoes. They have bulldozers. They have moved a tremendous amount of dirt across the railroad tracks out to where the water line would normally be. Now that water line is more of a peninsula. It had not yet as far as I can tell from here begun to recover any of the containers that are still sitting out on the water. A number of those containers, as we know, contain mail among other things. Those still seem to be sitting out there. They do have an awful lot of work left to do. However, you can see they have lights set up and it looks like they are planning to work all night, although one other complication just started about an hour ago. It again seems to be raining fairly hard out here."

That was what we referred to as the mud flood. After viewing this film, it's easy to see what Mother Nature can do to us and how vulnerable we are.

Before we look at a few photos of some damages we sustained on the Burlington Northern Santa Fe, I would like to give you a brief overview of the specific division.

The headquarters of the Pacific Division is at Seattle, Washington. We have about 1,400 miles of track on our division. There is heavy intermodal and grain traffic which are the mainstays of our traffic base out in the area. We have several major rivers that challenge us from time to time in western Washington.

We also operate over the Cascade Mountains via the Stevens Pass route and the Stampede Pass route. We have over 2,300 turnouts on the division as well as 604 bridges totaling about 20 miles including nine draw bridges. We also have 19 tunnels totaling 16.9 miles, the longest of which is the Cascade Tunnel which is 7.78 miles long.

This photo summarizes the service interruptions of one day or more during the first quarter of this year. I know it's an extremely busy photo and that you can't really tell all of the stuff that's going on there. Basically all hell broke loose is about all you need to know. The longest service interruption was between Seattle and Everett, Washington, and that was out of service for about nine days.

This is a picture of a train between Everett and Seattle for a distance of about 30 miles. It is extremely unstable hillside along this route which was formed by glacier activity some 15,000 years ago covering the area in a sheet of ice about 3,000 feet deep. There are glacially compacted soils which are very dense and that is overlaid with shallow, loose soil on top. The shallow, loose soil becomes saturated along with the shallow-rooted trees which can't penetrate the densely compacted soils and the results are slides.

This particular photo is between Seattle and Everett. It's difficult to appreciate the full scale of the photo because you really can't see the whole thing. In this case, it was about 12 to 15 feet high and covered the track for about 150 feet. We also had to lay about five track -- panels at this location.

This photo shows another location between Seattle and Everett. Early on, we did secure an emergency permit from the Corps of Engineers to deposit up to 60,000 cubic yards of material into Puget Sound as long as no man-made materials were deposited into the water. We also had to continually monitor any trees that would drift out and become hazards to navigation. In fact, we employed barge operators to retrieve quite a few of the trees at a cost of about a quarter million dollars.

Much of the area between Seattle and Everett is covered by retaining walls and slide fences. As you can see, there are a lot of trees that came down mixed in with the slide debris. We are actively pursuing cutting of all of those trees to help eliminate some of the elements that trigger the slides with the additional weight and torquing of the roots on the shallow soil.

This is a picture of a shallow skin slide. All in all, we had about 260 slides between Vancouver, Washington, and Vancouver, British Columbia, ranging from 10 cubic yards to 100,000 cubic yards.

This photo is the slide at Woodway between Seattle and Everett. It occurred about nine days after the line was reopened from the initial batch of slides that we had. This particular mess took us about two and a half days to clean up and re-open the track. There were five railroad cars derailed and 12 containers swept into the Sound when the mud slide hit.

This is a shot of the cleanup underway. We had to use barges working during times of high tide to retrieve the derailed cars and containers.

This is a view of that same area after the clean up was completed looking up towards the top of the bluff. There is a convent up on top just a short distance back from the edge. There is also a 40,000 gallon swimming pool about 20 feet from that scarp on top. The nuns told us that they didn't think they would be using that anymore.

Up on our Bellingham Subdivision between Everett and Vancouver, British Columbia, we had many mud slides. This is a picture of one of those and the embankment failure up above that caused that slide.

Switching over to our Stampede subdivision between Auburn and Pasco on the newly opened line, we also had our fair share of problems. This is just one slip out location which occurred as the train was going over the track.

This is another view of the failure area. That's just looking at the toe of the fill where the blowout occurred. We got in there with an excavator and dug a trench and filled it in with a riprap footing. We then took about 80 dumps of riprap to fill the hole.

Moving up onto our Scenic subdivision between Everett, Washington, and Wenatchee on the Stevens Pass route, this is up in mountainous territory with two two-grade with heavy curves. We had a shalely kind of a rock slide. There was a train coming down the mountain and it hit the slide. It derailed three units and one five-pack stopped short of coming down the mountain. If he would have gone another 40 or 50 feet, he would have gone over the edge and had one hell of a ride.

On this picture you can see the failure area above the engine.

While all of us big boys were playing in the mud, we also had severe winter weather in the mountains and on the east side of the Cascades. We were challenged on the newly opened

Stampede Pass route as well as on the Stevens Pass route through the cascades.

This is a shot of our Stevens Pass route just west of the Cascade tunnel.

This particular photo shows the snowfall and precipitation data from November of 1996 through March of 1997. As you can see both our snowfall and overall precipitation was up from what would normally be considered the average amounts for this period of time.

With particular interest, I would like to point out the Stampede Pass. In this area in this time period we had 614 inches of snow. The Stevens Pass route had 630 inches of snow. Also in December both of those routes set new monthly records for snowfall. The Stampede Pass route had 232 inches of snow in the month of December and Stevens Pass had 215 inches of snowfall during that same time.

We had some bridge problems as well. This photo shows quite an accumulation of drift building up by one of the bridges between Everett and Vancouver, British Columbia. We worked very hard to try to relieve the pressure on the bridge. As you can see there was a lot of drift there. It was 15 to 20 feet deep. We were not successful in preventing problems at this structure; we did have one pier that washed out.

You can see the deck of the bridge sagging. They had to place quite a bit of fill in the area in order to mobilize equipment. They also did drive in piling and the line was put back into service.

We had similar bridge problems on the Stevens Pass route over by Wenatchee, Washington. There was an obvious problem with the bridge. Again, the heavy river currents scoured out around the pier causing it to slump over. They drove piling on each side of the existing pier, placed caps and cross caps, and eventually encased the old pier within the new pier.

On the line between Vancouver, Washington, and Pasco, Washington, we also had problems. You can see the washout and the 235 excavator sitting under the track.

This is a picture of the cut from hell at Castle Rock, Washington, on the Seattle subdivision between Seattle and Portland, Oregon. It's two main track territory with about 80 MGTs annually with eight Amtrak trains a day. The main track was out of service for about seven days. This particular cut is about a half mile long. We had between 700 and 800 trees that slipped down with associated mud and soils and landed right on top of our tracks.

It was about six or eight feet high with mud and trees throughout the whole cut. We hired professional loggers to come in and cut the trees into more manageable size chunks that the excavator could grab and load into the bucket of a front-end loader. Basically we had to clean the cut out one bucket load at a time. Because of the poor drainage that existed in the cut you can see the ditches were full. The loaders literally had to carry bucket loads of rock and dump in order to keep removing the mud material from the cut because they would sink into the roadbed.

Once we got the rails scraped off and the rails that were overturned cleaned off and spiked back down, we used the slot train to restore the ditches and the drainage through the cut. We hauled over 140 carloads of mud out of this one cut.

Here is a picture of that cut today. All of the trees were removed, the slopes were graded where required, they were hydroseeded, and the track then was undercut and retied.

This is a photo covering both main tracks on that same route. You can't even see the tracks. It also blocked the northbound and southbound lanes of Interstate 5. It's difficult to tell, but there is a vehicle located right in the center of that photo buried in the debris.

If there is one thing I have learned over the years, it's don't ever say it can never get worse than this.

This is not a picture of any recent event, but actually occurred in 1964 on our track going through the Rocky Mountains in Montana. As the story goes the mainline was out of service for about 30 days. So I hope to never witness that type of an event.

All total, the damages from our last two winter storms is around $15 million. Additional funding is being spent to support a multi-year program that will enhance drainage by cleaning ditches, cleaning and installing culverts, re-grading slopes, installing trench sub drains and other subsurface drainage work. We will also be repairing and constructing retaining walls, sea walls and slide fences. We will continue with a program of logging our right of way on unstable hillsides and additional riprap will be dumped along several rivers in conjunction with erosion control and stabilization projects.

I would like to take this opportunity to give credit in the absence of many of those workers and say how privileged I feel to have had the opportunity to work with some of the best track, bridge and building, and signal and communications personnel in the industry. Without all of their knowledge, dedication, and hard work, times like these would be unbearable.

I hope you enjoyed the presentation. Thank you very much. (Applause)

Mr. Sensing: Thank you, Mike and Bill. We have some certificates of appreciation to give to you. What goes with that is, of course, our very nice hats that we always give everyone. Thank you again.

Tom Long is going to introduce our next speaker.

Mr. Long: Thank you, Andy.

Our next report this morning is Effective Road Crossing Construction and Maintenance Practices. It will be presented by Darryl Gabriel, division engineer, Burlington Northern Santa Fe.

Darryl began his railroad career as a trackman in Atchison, Kansas, with the Santa Fe. In 1990, he was assistant director of maintenance in Houston. In 1996, he moved to Springfield, Missouri, and is currently the division engineer for the BNSF.

Darryl is a member of Roadmasters and AREA. Please welcome him forward. (Applause)

COMMITTEE REPORT

EFFECTIVE ROAD CROSSING CONSTRUCTION AND MAINTENANCE PRACTICES

Darryl Gabriel

Division Engineer
Burlington Northern Santa Fe

Thank you, Tom, and good morning.

The phrase "road crosses grade" is generally associated with problems in the railway industry. It brings to mind problems with car/train collisions, slow orders due to surface and alignment failures, complaints from highway users and governmental agencies, and a large consumption of our maintenance dollars.

I am sure that most of you can think of several additional challenges to a maintenance manager created by road crossings. All of us have, at one time or another, wished that a particular crossing would simply go away. But we must keep in mind that in many cases one particular crossing on your property may be the single item that creates a general public's

perception of your entire operation. A railroad's best public relations campaign can quickly be undermined with negative publicity by one heavily used rough road crossing.

Today we are going to take a look at general road crossing surface materials and the roadbed rehabilitation methods based on experiences with life cycles of many road crossings. Please can keep in mind my comments are not intended to encourage or discourage any specific manufacturer's product.

Let's take a look at four different types of crossing surface materials in general use today:

1. Dirt and gravel. This is probably the first type of crossing material used. It has some obvious disadvantages since the product tends to hold moisture. You can count on dramatically shortened life of your track structure and components. Also, access for maintenance is time consuming and maintaining through flangeways can be a problem in areas graded by outside parties.

On the positive side, initial cost is as cheap as dirt. Asphalt coating will decrease some of the moisture infiltration and provide a better highway surface. The asphalt generally tends to break up in the flangeway unless some other type of material is used to hold the flangeway open. As with dirt, access for maintenance is time consuming and disposal or reuse of asphalt can prove difficult.

2. Wooden plank crossings are probably one of the most common crossing surfaces in use today. The disadvantages are basically limited to the life of the wood either through abrasion or decay. Initial cost is reasonable. The industry average per foot for a full deck wooden crossing is about $57 per track foot. Access for maintenance is very good and if properly drained, accumulation of moisture is not a problem for the track structure.
3. Composite crossings of fiberglass or rubber became popular with many state DOTs during the 1980s and early 1990s. There are still many examples of this product existing today that are providing a good surface if they were installed on a sound track structure. They tend to wear well except where there is heavy turning highway traffic.

Most of the designs do a very good job of shedding water away from the track structure and providing the stable crossing surface for the highway and pedestrian traffic. However, the initial cost is high compared to wood with an industry average at about $140 per track foot.

Access for maintenance is generally time consuming since most designs of interlocked panels make it necessary to remove all of the planking from one end of the crossing to the point of desired access. Also many of the designs require an extraordinary number of lag screws.

4. Precast full deck concrete panels have been the choice of many railroads since the early 1990s. They come with as many different designs as there are manufacturers and managers of standards. There seem to be very few problems with concrete crossings provided they are shipped and installed without damage. This damage is generally limited to corner spalling or bumps.

This picture shows one and a half year old derailment damage done by a loaded coal hopper. As you can see the initial impact is on the end of the panel and along the flangeway. These spalls have not changed since the time of the derailment.

The only manufacturing defects found have been limited to some cases of poor quality concrete and some minor surface cracks that have been covered by the manufacturers' warranties.

There have been some problems with the corner strapped crossings as shown here.

There is perception of many signalmen that the angle irons contribute to track shells. We have found that in most cases, however, this is due to poor drainage of the track structure combined with foul flangeways. We have also observed on a few crossings that the corner strappings have separated from the concrete. Most of these failures have been due to mechanical damage or the induction of excessive amounts of heat when welding the panels

together. This causes the middle to warp and lose its seal with the concrete again allowing moisture infiltration.

Most concrete panels were designed for installation on standard wood or concrete ties. Some manufacturers are casting flangeway pillars into the crossing panels as shown in this photo. The average cost per foot for precast concrete is about $150 per track foot.

One of the more innovative uses of concrete are the tub or slab crossings. These crossings require no track structure other than the running rails. Generally the manufacturer recommends traffic not to exceed 20 million gross tons or 20 miles an hour. They are very well adapted to light density rail traffic with heavy vehicular traffic. This type of crossing has been in place for about four years and carries about 15,000 65 mile an hour vehicles daily and a coal train weekly. It shows no signs of surface wear or loss of track geometry.

The cost is generally less than that of standard crossing construction with concrete surface.

From the perspective of train operations, the type of crossing surface chosen for a crossing is much like choosing the color of a new car. It may look different, but the mechanics underneath the paint are what truly dictate how long the car or, in our case, the crossing will last. The majority of road crossing failures are not related to track crossing surface, but to the failure of the subgrades supporting the track structure. The most expensive crossing surface cannot perform if it is not placed on a stable well-drained track structure.

The key elements needed to obtain maximum life from the track structure of a road crossing are:

1. Good drainage to prevent the saturation of the roadbed and prevent subsequent loss of strength to the roadbed.
2. Ballast section confinement to allow the ballast to develop its maximum sheer strength.
3. Separation of the track ballast from the subgrade to keep the ballast section water permeable.

First and most important to the track structure is drainage. There are many ways to accomplish drainage of a road crossing such as French drains, plumbing with perforated pipe, or allowing the water to sheet drain through the ballast section and exit the corner of the crossings. The method used to purvey the water from the road crossing must be installed on a grade below the lowest layer of permeable material in the crossing to allow water entering the crossing to escape thus preventing saturation of the subgrade.

It is the experience of the committee that the majority of water entering the crossing migrates longitudinally through the ballast section of the adjacent track. It tends, therefore, to pond at the point of the track structure that has the poorest side drainage or cross drainage. Many times this turns out to be the road crossing.

Here are some photos showing the results of poor drainage practices. This slide shows a crossing that is located at the high point of a highway and a low point in the track structure. This crossing obviously was receiving a volume of water greater than its ability to drain. As you can see, the ballast section is fouled with liquefied subgrade.

The ties you see in this picture are less than one year old and they show two to three inches of thickness loss due to abrasion from pumping. Once excavated below the ballast section into the top few inches of roadbed, you can see that the subgrade is stable and dry. This expensive failure could have been prevented had the corners of the crossing been excavated to allow water in the crossing to drain out as well as if cross drains had been installed at each end of the crossing below the ballast section to intercept water migrating through the adjacent ballast section into the crossing.

This photo shows the subgrade and subsequent track surface failure of a tub or trough-type crossing. The crossing was installed on a compacted sand base that did not have any type of a drainage system. Consequently, water ponded in the crossing to the point that the sand base liquefied. The sand was pumped out of the crossing at the end and even through the joints

in the tub panels with each vertical load placed on it by passing trains undermining the support for the crossing. This crossing was repaired by pressure grouting. The grout displaced the water and also effectively sealed the sand base from further moisture infiltration. This was an expensive repair that could have been prevented had adequate drainage been installed.

The appropriate method of drainage for each crossing will be dictated by the factors of surrounding terrain and by following long-standing trackmen's rule. The water has and always will run downhill — even on the railroad.

The second step to getting maximum life out of a road crossing is roadbed stabilization. This topic has always been controversial and rightly so given the numerous soil and moisture conditions spread across this country.

The committee has narrowed the best practice for stabilization to two basic methods that will provide adequate support for track structure and a variety of soils. The first method is the use of select aggregates. This method involves up to 33 inches of excavation below the bottom of the tie. This number will vary depending on the varied stability of the soil you are working with. In the worst case you would start with five or six inches of road base material, followed by eight to ten inches of washed sand, followed by four to five inches of half inch or finer washed ballast, and finally a standard ballast section. All materials should be mechanically compacted as installed. Care must be taken to see that the water is not trapped in the crossing at any point above the bottom of the sand layer. The half inch washed ballast worked to contain or prevent the larger standard ballast from penetrating the compacted sand beneath. The compacted sand tends to strengthen the track support by uniformly distributing the load to the subgrade.

Another benefit of this type of installation is that all the materials can be readily stockpiled in advance of the project and the material cost is minimal. However, the installation of these materials is time-consuming and very unforgiving if proper drainage is not provided.

The second method recognized by the committee is asphalt underlayment. This method can require up to 20 inches of excavation beneath the bottom of the tie. The asphalt is placed as a layer between the roadbed and the ballast and basically serves as a sub ballast. This process involves installation of at least four inches of mechanically compacted asphalt. If time and equipment availability prevents the use of a roller compacter, the asphalt thickness can be increased from six to eight inches and then wheel rolled with a backhoe or front-end loader.

The advantages of asphalt underlayment at highway crossings are it provides a resilient, strengthened support layer below the ballast and uniformly distributes the load to the roadbed. Also, it provides a waterproofing layer to the roadbed providing a layer to divert water to adjacent drainage structures and eliminating roadbed moisture fluctuations. A high level of confinement for the ballast section is created to develop a high sheer strength without increasing track stiffness.

The installation of asphalt underlayment is very straightforward. After excavation is complete, the hot, mixed asphalt similar to that used for highway pavement applications is placed as a layer directly on the roadbed. This layer should be graded to allow water to flow out of crossing.

This can be accomplished as shown in this photo. With a perforated center pipe, the drainage can be maintained at the crossing ends or the asphalt can be sloped as shown in this photo to allow water to flow out of the corners of the crossing. The upper right-hand box of this photo shows the recommended mixture for asphalt aggregates along with the tons per square foot of varying thicknesses. Ballast can then be installed directly onto the asphalt. No cool-down time is needed. The asphalt is then graded and the track structure is installed or, as in these pictures, dumped directly from ballast cars with the track structure sitting on the asphalt.

These photos show the installation of a tub or trough-type crossing directly onto the asphalt underlayment. A motor grader and a loader were used in this installation.

In closing, I would like to show you a photo of the best highway crossing any railroad could have. You can't see it, but it's a grade separation. (Laughter)

These informational handouts are available in the back of the room to provide details of the cross-section photos and asphalt gradations.

Thank you for your time. (Applause)

Mr. Sensing: Darryl, I have a certificate in appreciation of your efforts and your committee's efforts for this report and I thank you for a very fine job.

Mr. Gabriel: Thank you very much.

Mr. Franz: Our next speaker this morning is John Menge from Seaward International. Before I finish introducing John, I just want to mention that there are some handouts related to Mr. Menge's presentation that will be in the table outside in the hallway.

John Menge is vice president of Seaward International. He has been in that position for the last five years. Prior to joining Seaward International, he had 20 years experience in capital marine equipment sales and construction. Prior to Seaward, John was vice president with Hubbard Construction Company in Jacksonville, Florida, and also McDivitt and Street Construction Company out of Charlotte, North Carolina.

He has a Bachelor of Arts degree in economics from University of the South.

Mr. Menge joined Seaward International in 1992 to start up their engineering plastics division. He is going to talk to us today about some of the uses of composite bridge materials. Please welcome John Menge. Thank you. (Applause)

COMPOSITE BRIDGE MATERIALS

John Menge

Seaward International

Thank you, Dave. What we are going to be talking about this morning is the use of composites. More particularly, the use of composite plastics in bridge fendering systems is the particular angle that we will be looking at this morning.

Principally, the way we will address ourselves today is we will talk briefly about the U.S. railroads and we will talk about composites technology. We will talk about Seaward International and particularly our composite plastic products, their applications, and the technical data.

Let me start off by letting you know a little bit about Seaward. Seaward is headquartered in Clear Brook, Virginia, which is the northern part of the Shenandoah Valley. We are an employee-owned company and we have been in business since 1974. We employ over 100 people. Our annual sales are roughly in the $20 million range. We are principally the largest manufacturer in the world of foam-filled buoys and flotation devices. We sell our fenders and buoys literally around the world.

We have two plant locations in the Shenandoah Valley, one is the main office in Clear Brook and our plastics plant is in Winchester. Our traditional focus has always been on the marine industry. As I said, we are the largest manufacturer of foam fenders and buoys in the world.

The U.S. railroad system, based on data we get from industry organizations, basically

allows us to help focus a little bit on a very small niche of your market and that is railroad bridges, and principally those across navigable streams and waterways.

Composites in the rail industry offer the same benefits to people as they do in the general marine industry. These principally are the reduction and replacement requirements for traditional timber whale beams and pilings down in bridge fenders, reduction in maintenance costs associated with that, and improvement to public safety and improved product quality. The typical product found today in a typical bridge fender, and it doesn't matter whether it's for a railroad bridge or for that matter a DOT, is comprised usually of either creosote or CCA treated horizontal weld beams. These are typically ten by tens structured onto vertical pilings. These pilings are typically 13 to 15 inches butt diameter of piles on the verticals. Some of the DOTs in some of the southern states, Florida, for instance, have now gone to vertical concrete piles.

The principle reason for the introduction or the replacement of the vertical timber piles with vertical concrete piles is that as a result of marine borer activity that has continued to increase in this country as a result mainly of the Clean Water Act. The Clean Water Act was mandated by Congress and did take hold. As a result, the navigable streams and waterways of the United States became cleaner. The marine borers in some areas such as New York, for instance, had been virtually nonexistent for decades and now they have started to return. As this has happened, it has coincided with EPA regulations that have tended to discourage and in some cases eliminate the use of creosote-treated piling. Creosote tends to be the most effective means of blocking marine borer activity in traditional vertical wooden piles and horizontal weld beams. That effectiveness has been to open up these wooden products to faster decay associated with marine borer activity. As a result of this, any collision with a passing vessel to these timbers and pilings that have been affected in this fashion will cause the failure.

Typically bridge maintenance people will associate the failure with the collision not realizing that perhaps the structural member or the fendering system had been already weakened as a result of the activity from the marine borer.

The functional characteristics of plastics and in this case we are talking about plastics used in a composite form that lend itself to marine-related environment are that it is aesthetically appealing, it never rots, it is virtually maintenance free, and it is corrosion proof by itself not taking into account any fasteners that may be required. It is also non-absorbent and by that we mean it does not generally absorb freshwater or seawater. It is termite and, of course, marine borer resistant.

Thermal plastics can be made in a very good color-fast type of form so if, for instance, you need to have very high visibility on the water other than black or brown, it can be done in colors very easily. Typically, plastics do not splinter and spall. This is especially true of the types that are used in composites and the ones we deal with, the high density polyethelenes, which have elongation characteristics. The freeze/thaw cycle and the damage that the freeze/thaw cycle can inflict on traditional wooden beams and pilings is not an issue here with plastics. Of course, it is also stain resistant and they are all warp-proof.

What we are going to look at here are actual examples of installations made by the type of composites that our company manufacturers. We will talk more generically as the talk progresses.

We market two different types of products in the marine environment under the trade names of Sea Pile and Sea Timber. These products are composites to the extent that they have been manufactured from 100 percent recycled plastics. At the same time, they are structurally reinforced with fiberglass rebar. We utilize the fiberglass because it is noncorrosive. It is also nonconductive. Plastic, by itself, does not lend itself to any kind of use in a fendering system without some form of stiffness being added to it.

There are a variety of ways to doing this. Our company has focussed on a patented process of ours which places the fiberglass rebar in certain discreet locations. Then as the piling is continuously extruded this rebar becomes a part of the product itself. This is the main

reason why the piling or the timber will have stiffness levels that far exceed that of normal unreinforced plastics.

Both of our products are continuously extruded and what that principally means is that these are obviously not molded. They can be made to any particular size or length. They come through a dye. The basic source of the material that we use is mixed-color recycled plastic. This principally is high-density polyethylene although there are some blends of low density and medium density as well. All of it is 100 percent recycled. The recycled plastic is put into a blend and goes into an extruder and it thus flows into a dye. The rebar that you see here is ready for manufacture. It is already made to whatever the discrete length the timber or piling product will be manufactured. It, too, is placed into the back of the dye.

One of the features and benefits that you find from this type of composite is, first off, that it is made from 100 percent recycled plastic. We have a trade name that we use for this which is Duralin which is basically a formulated type of thermal plastic that uses among other things ultraviolet inhibitors and antioxidants to help create a longer living product. We also mix carbon black in with the cross section to also protect it from ultraviolet light. We make it through a process we call core extrusion which means that the foamed thermal plastic center of the product is different from the unfoamed thin skin that goes on the outside. It is this thin skin that can be colored to any different type of shade if, for some reason, your safety people would require this be done.

You will see in some of the photographs here today and also in the literature we have outside where we have had requirements, for instance, for the Port of New Orleans where they wanted the whale beam system in between vertical piles to be OSHA yellow. We have also provided green and red piling to the United States Coast Guard. They are currently testing them in St. Petersburg out in Tampa Bay for aids to navigation work.

The plastic itself is generically high-density polyethylene. Foamed or unfoamed, it is going to have a very low coefficient of friction. This is a very key element to the functional characteristics of composite and particularly Seaward's composites as the bridge fendering system. The coefficient of friction of Sea Pile and Sea Timber is approximately one fourth that of cut wood. If a vessel or barge transits underneath one of your bridges and comes into contact with the bridge fender, the vessel tends to want to slide a lot easier across the surface of our composite than it would normally against the wood. This also helps to significantly reduce the checking and spalling issues that are involved in traditional wooden products.

It also has the added benefit of helping in icing conditions where you have a situation where you can have a lot of freezing during the wintertime and the ice can literally get into the cracks of the wood. In some cases at high tide it lifts piling up out of the ground and carries them away. This is what happened in Curtis Bay three years ago outside of Baltimore during a very severe winter.

The coefficient of friction of pilings in the timber we use is such that the ice has nothing to stick to and it tends to slide up the surface of the pile.

Of course, it's impervious to marine borers. Tests by the United States government have proved that marine borers don't eat plastic. If time permits, I would tell you how your tax money was spent to determine that. However, you really wouldn't want to know. It's amazing how much money was spent.

Our poly fabricated is a one-piece unit as mentioned. They are continuously extruded and can be made in any transportable length. They do not contain any chemical preservatives or creosote. All of our products have been subjected to a T-clip which, for you who are uninitiated, means toxic characteristic leaching procedure. It's an EPA mandated test and basically the Sea Pile product and Sea Timbers products are listed inert. They can be installed with industry-standard equipment, any kind of driving hammer, and any kind of bolt or fastener can be used. As mentioned before, custom colors are available and the products are, of course, laboratory and field tested.

here and again is available in the report compares various different fender pile dolphin installations using southern pine as the basic wood and then three different sizes of composites.

Let me say to you now that the way we change the stiffness level of all of our composite materials is simply by varying the diameter of the fiberglass rebar we use and the quantity of that fiberglass rebar. Also for your design folks, we have included in the handouts all the calculations that have been used to derive this data. Principally, what we are able to do is show you the predicted dolphin energy absorption characteristics for either a seven-pile cluster or for a much larger 19-pile cluster using wood versus using the composites.

The composites will far exceed the wood in their performance characteristics. Basically what this means is the dolphin is there to help deflect and absorb the loads of a barge that is coming out of channel and coming in towards your bridge fendering system. If it hits a dolphin cluster that is manufactured out of composite, you are going to find that it's much more efficient in its ability to absorb energy. That is the key reason why you are putting this there.

A lot of people think the dolphin is simply there not to budge, but to stop it. A lot of the barges that are transiting the waterways today aren't going to be stopped by a 7 or 19-pile cluster. What you want to do is absorb that impact and absorb that energy. This can be done very efficiently by using composites.

I always like to close any presentation I make with a very simple photograph that illustrates the differences in what we are talking about. On the left is a traditional creosote fender pile. This piling is in use throughout the country. It certainly is very prevalent in the bridge fendering systems that you have on many of your bridges.

On the right-hand side is the next generation and this is a composite. The composite compares very favorably to wood. It is an engineered product and thus it can present you and your design people with predictable performance characteristics pile after pile, whale after whale unlike wood which has to be severely de-rated in its engineering capabilities because of the fact that it is a variable product.

We are not the only company that is working on composites. We are just one of many. I will share with you that there are great strides being made right now in the use of composites in the marine environment not only for fender use, but also for load bearing use as well. The type of composites that you see today just happen to be the first that people have brought onto the market. We are the largest manufacturer of composite plastic material in the marine market right now and we have been fortunate enough to receive two patents on both our process and the products that we offer.

However, there are other companies that are working out there right now, and many of them you have seen and you may hear of and perhaps they will come and address you all in the future, principally looking at load-bearing opportunities for the use of composites. The net effect of all this work by companies like Seaward International and other companies in the industry is to provide you in the bridge maintenance business with products that will increase the life expectancy of your whale beam systems and your fenders and verticals.

Importantly, and a lot of people don't quite pick up on this sometimes, this will reduce safety hazards to the public. As many of you can imagine, if a whale beam system or a fendering system has been damaged by a transiting vessel frequently, the fastener is still left in place. This is like a big spike just sitting out in the middle of the waterway for a vessel to come alongside and maybe even somebody will get hurt. Of course, this also reduces the long-term maintenance costs that are associated with the ongoing and really never-ending requirements for continually replacing the damage to rot caused by marine borers and impact that you find on your bridge fendering systems.

I would like to thank you for letting me come here today. If you have any questions, I would be more than happy to answer them. The handouts in the back will give you the engineering data to support a lot of the things that you have seen here today. Again, thank you very much. (Applause)

Mr. Franz: I would like to thank John again for a really interesting presentation and give him a certificate as a token of our appreciation.

Andy Sensing will introduce our next speaker.

Mr. Sensing: Thank you, Dave.

Our next presentation is Challenges of Maintenance on Other Continents. The presenter is Chris Dodge, vice president and chief engineer of Railtex headquartered in San Antonio, Texas. Railtex is an international company with railroad operations in the United States, Canada, Mexico, Kazistan, and Brazil. Railtex currently has 28 railroads totaling 38,000 miles.

Chris began his railroad career on the Santa Fe after receiving his Bachelor of Science degree in civil engineering from the University of California at Berkeley. After 20 years with Santa Fe in a variety of positions up to and including general director field operations and general director of maintenance planning, he joined RailTex as their chief engineer in April of 1995. Chris was promoted to his present position in June of 1997.

He is a registered professional engineer in Arizona and is a director with the Roadmasters and Maintenance of Way Association, member of AREA Committees 16 and 18, and a member of the American Society of Civil Engineers.

Please join me in welcoming Chris Dodge. (Applause)

CHALLENGES OF MAINTENANCE ON OTHER CONTINENTS

Chris Dodge

Vice President and Chief Engineer
Railtex

Thank you, Andy, and good morning everyone.

As Andy mentioned, my topic this morning is the challenges of maintenance on other continents. What I would like to do is give you a little bit of feel if you ever have the opportunity to go to work for or explore another railroad system on another continent. I think you will find that quite a bit of what we do on the North American continent is applicable to going elsewhere. There are a lot of challenges out there, and a lot of opportunities.

Some of the opportunities that are out there include ongoing privatization efforts. Many of the governments throughout the world are taking a look at their existing federal railroad systems, privatizing them, and turning them over to private industries or consortiums who come in and run a more efficient operation. In addition to the government organizations that are privatizing, there are also some privately owned railroad systems that, again, are doing the same thing. They are looking for an outside operator to come in and bring efficiencies into the operation and improve the profitability of their railroad.

There are numerous companies, Railtex being one, Wisconsin Central, Genesse and Wyoming as examples, and other numerous companies in the United States and elsewhere that have been involved in the process. There also are many engineering firms that have been doing a lot of work throughout the world on railroad systems that are avenues to explore.

I would like to address two particular areas today: The first one is Brazil as we have been very active in Brazil. The privatization process was started down there a little over a year ago. The first railroad that was privatized was the Ferrovia Novesta, which was a shortline in the center part of Brazil. We became involved down there with the privatization of the second segment which became the call of the Ferrovia Centro-Atlantica. It is approximately 7,100 kilometers or 4,400 miles. The majority of the gauge is a 1.0 meter; however, there is some dual gauge of 1.6 meter.

The second area that we have been involved in down there is Ferrovia Sul Atlantico which is in southern portion of Brazil and approximately 4,200 miles long. Again, the majority of that railroad is 1.0 meter gauge also.

This is a map of Brazil to give you little idea of where the various railroads are. The Ferrovia Centro Atlantica goes from Salvador down to Rio de Janeiro and down to the federal capital of Brasilia. The Ferrovia Sul Atlantico is on the southern portion of Brazil from Curitiba down through Porto Alegre. This is what interchanges into Argentina.

As part of the process for the privatization, they have the inspection and the due diligence process. You will get volumes and volumes of material that will make accountants just happy as anything as they go through and read this stuff. There is a lot of information on track conditions, programs, et cetera. However, I think we all find that what you need to do is get out and kick the tires so to speak. You need to get out on the railroad and find out exactly what conditions are out there to be able to take those conditions that you see, go back to the printed material, and make a comparison to see if the printed material is accurate and reflects the actual conditions out there.

As part of this on-site inspection, you are going to be running across numerous methods of inspection vehicles. Because of the meter gauge, there were no hi-rail vehicles.

This was an on-track inspection vehicle that was used on our trip. This particular one was the deluxe model. It was the superintendent's vehicle and it had air-conditioning which was a pretty good luxury down there. At that time of year it was well worth it.

The other vehicle that we had to use the majority of the time was equal to the division engineer or roadmaster's inspection vehicle. There is good visibility in these. In this one the air-conditioning was when you opened up the windows.

Then there was the economy model which was the section vehicle. It had the wide open doors and wooden bench seats. We did a few inspection trips on this one, too.

One of the interesting things we found as we got further along this process was the windows in these vehicles were just straight plate glass. The reason we found that out was after we took the railroad over we had an injury with a bird hitting the windshield and breaking the glass and the driver getting cut. In the process of doing the investigation to find a root cause, we discovered that all these windows were just pure plate glass. There was no safety glass involved. That was one of the changes we instituted when we got down there.

There are numerous areas on the railroad that you are going to be looking at. One, equipment and materials that are present on site both in track and also out on the stockpiles so that as you take the railroad over you will know what you have to start with.

Again, this is the section vehicle. It has two trailers behind it. The roads were minimal along the right-of-way out here. Basically in the morning they would have a driver who would take the section crew out and drop them off at various locations along the line to do their work. Then at the end of the day, the driver would come back out and pick them up and bring them back to the headquarters point.

There were a few manpower movers with some small cranes on them. Again, they were few and far between.

One of the things that we did see which was kind of interesting was the servicing equipment in Brazil was high powered versus what we came to expect. However, both types of equipment that are down there are meter gauge. Looking at new replacement machinery

became an interesting concept when you start talking prices compared to what we are used to in the United States. Then you start looking at the same machine on a meter gauge basis and taking it down and importing it into a country and seeing what that changes for your prices.

This is a welded rail train that they had down there. The rail was welded where we were standing, rolled on down the line, and then they had a series of overhead cranes that picked the rail up and lifted it up over and set it down in the train. This train could hold approximately 32 strings of rail. Then they had two Gantry cranes that ran along the top of this train. When they got out to the site they would take and unload the rail on the ground using the Gantry cranes to take the rail and set it up on the shoulders as much as they could.

One interesting thing we found down there was that the surfacing was fairly high powered and technical. The tie replacement was by hand and they laid welded rail by hand. No cranes; just manpower. I asked the roadmaster how they did that and he just kind of gave me a one of these good muscle gestures that this is how they do it. I said, "I guess I understand."

This is one of the sections that we stopped and visited. They were doing some regauging in the track. There were some small machines that we saw again. They were mostly tie drill and bolt type things.

You will notice the gentleman with his back to us has his foot on the rail. That was one of the other things that we found down there regarding safety practices. They were pretty much nonexistent compared to North America. There were many golden opportunities for safety work practices to be implemented on these railroads.

These were some of the ties that they had. This was the economy tie or what they call a one-sided tie. It was basically where the plate was adzed off. These were subsequently treated and taken out to the railroad. This was, again, the economy model. Then if they were fortunate and could afford it then they had the deluxe model which was the two-sided tie.

Here is a picture on the center of a four-sided tie as we know now, but the two-sided tie basically was arrived at when you clean the top and bottom off, treat it, and put it in the track.

They did have some concrete. These were dual block concrete ties. These particular ties were made by the Army Railroad Division for a flood control relocation project. I inquired to the locals as to whether they used concrete ties for severe grade and severe curvature and they said they didn't trust them. Therefore they stayed with the wood. There were some steel ties being used in there.

They did have a plant on the railroad that did the manufacturing for their own switch points, stock rails, and frogs. Basically it was plant that had pretty much all rail bolted and nothing in the way of an inserted material.

Again, when you get out and start looking at the track structures you are looking at the types of conditions and any standards that are in affect. One thing I did find interesting down there is that each particular division had its own track standards. There were no federal track standards as we would know in the United States.

As you go out and talk with them about maintenance practices, again, it was a regional basis thing. There were no consistent, widespread applications. You also need to look at the core routes because as you develop your programs, you are going to want to focus your efforts on those core routes and what needs to be done to get them up to speed for your customers.

This was the railroad out of the federal capital of Brasilia. It was built in the late 1960s when the city of Brasilia was built and the federal capital was relocated from Rio de Janeiro out to Brasilia.

When the railroad was built, they had a very good philosophy. They did not believe in road crossings. As Mr. Gabriel mentioned earlier in his presentation, this was the best road crossing that we saw out there. Also the other thing, too, was they had a lot of the concrete drainage ditches through the cuts along both sides, good ballast, jointed rail, welded rail, and a mix. Again, there were some of the longer fills. They also had problems and we had the typical solutions. You go out there and drive rail for embankment stabilization.

This photo shows the various methods of track fastening systems used. Occasionally they would put anchors on, but there was no consistency to the anchoring pattern.

When we first saw this particular joint, it looked like it had been adzed or basically plate cut. What we came to realize is that they were designed when they laid the track at the various joints. They adzed out the tie and the joint. There is no plate underneath that and then they went ahead and put a screw spike in at the joints.

This particular type of spike was something that I had not run across until I had been down there. They refer to it as a dog spike. It's kind of a bent over spring clip. You can see the quality of tie that is in there. Again, this is one of the more unique locations as there was a tie plate on this tie.

At this particular location they had built the switch to the side and they were waiting for a traffic window to go ahead and take the existing mainline switch out and slide this one in. In talking with them, I learned they planned on doing this in approximately a six to eight-hour window. This switch was built to AREA standards. They did use AREA standards for their switches and turnouts.

The track structure down there varied in weights of rail from 115 pound to 90 pound to 75 pound. They did weld up 75-pound rail to use as replacement in curves. The 75-pound rail that we saw was approximately 1940 vintage. Part of what we saw as we went out there was a change area that we talked about earlier with concrete ties and the dual blocks. Both the mainline and the sidings on this particular segment were concrete ties and all welded rail. It had not been surfaced in approximately eight years and was very stable. It was also very smooth riding.

The stretch of track in this particular location had fiber optics buried along it. On the pole to the left with a yellow band, there is a steel access point for the fiber optics.

One thing that we did note down there is there is not a lot of room for wide loads through many of the cuts. As you can see through this shot, this is an S-cut. This is in one of those areas that even in the hi-rail inspection vehicle as you went down you didn't put your head out the window too far.

This is another shot a little further towards the coast. You will start to see some of the coastal vegetation versus the inland vegetation that was shown in the previous photo.

At this particular location we are coming up to a huge rock on the center of this photo that goes on up in the fog. There are a two or three waterfalls down the face of this.

This is a shot through the slide area or through the rock area. The large rock behind the people was a portion that used to be up on top of the mountain. It came down, and this line was out of service for two months while they blasted the rock out to open the line back up.

One of the things that we did see there were good markets for side boom operations for derailments. There were none. They used the good old derricks.

This particular derailment had two units and nine cars that went over the side. Fortunately no one was injured in this derailment. They got the track back in service and then they would come back in the spring of the year after the main grain season and pick it up and get it out of there.

In the Belo Horizonte area on the center part was the dual gauge track. Again, there was the 1.0 meter and 1.6 meter. The original lines in Brazil were basically 1.0 meter. Anything new that was built after the mid 1970s was dictated to be 1.6 meter. This particular segment was dual gauge. This was in the city down by the station at Belo Horizonte. Again, out in the country you have the mainline which is dual gauge switches and then over to the right in this picture is a dual gauge yard with a dual gauge lead. So, you have a lot of fun with turnout maintenance and just trying to figure out which switchpoint gets adjusted for which area.

This was a mainline crossover. Just to give you a feel for what these look like, appreciate giving the foreman a set of plans and a pile of material and telling him to go out and build this for you. One thing that we did tell our safety people is they did a good program down there

and they did mark their clearance points. Only trouble is they put them on the big yellow ball and a pipe right in the middle of the walkway. However, they did mark the clearance points.

This particular segment was what we called the crossover where they changed the common rail from one side to the other side as they were coming into a switch or into a particular area.

Going into the structures area we found the same thing looking at the types of conditions that are out there. Inspect records beforehand if you have the ability to access that. Review the standards and effects of any new projects that are currently under construction. This becomes critical when you look at the time frame of taking over the railroad. You might find that construction projects in the transition period sometimes get lost and information about what gets completed by the government and what gets completed by the new company is confused.

There is not a lot of margin of error on some of the side hill structures that we found down there. This particular one shows retaining walls at various stages throughout this canyon.

This is another shot where the track is on the side of the cliff and goes out onto a bridge over the other side of the valley going down approximately 1,000 yards.

This is another view from that location looking the other way to give you a little feel for the terrain that some of the railroad was built on. This was especially true coming from the coast up through the coastal range mountains and going inland. You can see some of the conditions of the ties out on the bridge. The bridge tie replacement program was pretty inconsistent as we found along our way.

This is a very interesting structure, both combination concrete and steel tangent and curve.

Here's another combination on the side hill. This is along the coast. You can see the different vegetation that is now existing.

This shows some of the structures that we found down there. Most of the original structures were built for a 16 or 20-ton axle loading. They were being retrofitted to a 27-ton axle loading. This is all meter gauge. This particular through truss had been retrofitted on the top for the heavier axles.

This is another structure which had been retrofitted. This doesn't clearly show in the picture, however the bridge tie condition across this structure was fair to poor at best. There was a lot of inconsistency in the tie sizes on the structure.

This was an evening shot as we came in one night. On this particular bridge, the channel on the outside of it was the fiber optic cable which was present on this particular segment.

In this next series of slides they had an existing through-truss bridge which was a historical bridge. However, they had a five mile per hour speed restriction and no braking allowed on the bridge restriction, so they were building a new bridge in conjunction with a line change downstream. The new bridge was to be a concrete pier steel structure and the steel was being reused from another location that they had taken apart and moved to this location.

Just to give you a little appreciation for construction methods as necessity, that is the scaffolding at the center pier on this structure. Then they had their concrete batch plant right there at site. When they were getting ready to make the pour on the embankment pier, basically what you are looking at is down the wet shoot which is where they would dump the concrete to the rebar down below.

The majority of the structures that we came across were steel. There were a few concrete. One interesting thing on this particular concrete bridge was the helper vents, if you will, underneath in the center part of that. It's always reassuring for a bridge person. Again, there are some very impressive structures. I think you will see the same thing down in Mexico. We saw this quite a bit in Brazil with the concrete.

This particular structure is kind of an open-box culvert. You can see the condition of the ties. There were a few tie plates on this particular one, but not many. They made the comment that they had a big problem with sun kinks on this line especially at these locations. This is on

a 3.6 percent grade. There is no fastening between the ties and the rail underneath it.

This particular picture shows one of the structures. The gentleman standing on top of the bridge was one of our Brazilian hosts. You can't see it clearly with this, but there are about three different sizes of bridge ties on that bridge not all of which are in contact with the rail, but they are on the bridge.

This particular structure was unique in that they had a five mile an hour slow order on it. They had T-rails between the abutments to keep the abutments from tipping over on each other. They also had steel beams on top of the bridge that were tied to the steel underneath it as additional support.

This particular location was rather unique also as this is a historic town. The track that takes off to your left goes across the bridge and across the river to the other side. The track to the right goes through the building and is the mainline that starts the 3.6 percent grade. The track behind you as you look at this is approximately 15 car lengths and this is their mainline.

What they do is they bring a train over, take and shove it up through the building with units on the point, go back and get the rest of the train, come back over on the move, connect it back up and then they go up this 3.6 percent grade. That is a daily move for their mainline.

They had looked at coming off the bridge with a curve and avoiding the building; however, the building is historical and there was a monastery right next to it from the 1600s which was historical that they could not touch.

This is a picture of the bridge. It turns out that the bridge also was the road bridge and the pedestrian traffic bridge between the two cities so the railroad had a watchman on both sides. As the trains came, they stopped the automobile traffic and let the train go across. The pedestrian traffic was on the outside walkways of this particular structure.

This is a shot of the structure going across. The wood planking was fastened kind of haphazardly across. As you watched the vehicle traffic go across this thing, especially the trucks, it was interesting to watch the wood planking bouncing up and down underneath the vehicles.

This particular picture is a little dark; however, there is some cross bracing that has rusted off and completely gone underneath the bridge. On the other side of the bridge you came off you went around approximately a 10 to 12 degree curve. Then you went about a half a mile through the middle of the street again to the depot where the yard was. There is where you picked up the rest of your train.

We found the signal systems to be an interesting type of dispatching system. It was something that I think a few in the room can appreciate. The first one we came across was the Morse Code. This is how they were moving their trains out on the interior portion of the line. They basically had operators at each station and they were key coding to each other to get the train from station A to station B. Then they talking about installing C.T.C. in that dual gauge portion. When they got the C.T.C. installed, they were going to take the English staff system which was used there and take it out and use it to replace the Morse Code.

This was the staff system that was in use on approximately 90 percent of the railroad. Basically the operator would crank to the next station, get a green light, pull a staff out, give it to the engineer, the engineer would go to the next station, and give it to the station agent who would give him another staff to go on. That's how they moved their trains. When we inquired to them about using a track warrant block system and using radios, their question was, "Is it safe?" So there is a lot of opportunity for new systems down there.

One of the things we did see is they had a couple of areas where they were installing new C.T.C. panels. In conjunction with the C.T.C. they were doing some installation of the signal systems out on the railroad. This was through the dual gauge area. The signal system was installed and being maintained using a combination of contract and railroad employees.

There were some road crossing warning devices that we came across. This particular location had gates and lights. When we came up to it, though, it was interesting because we

asked whether this track was actuated. They didn't know what we were talking about. It turns out that the guard tower either has a railroad employee or a town employee depending upon the deal that the railroad had made. That employee in there flipped a switch when a train came, the gate came down, the train went across, he flipped the switch, and the gates came back up again. So there is definitely some room for improvement and some opportunities down there in the signaling area.

I would like to change continents a little bit. I had an opportunity to look at Australia and specifically Tasmania. The Australian National has been putting this up for bid. This particular one was just awarded two weeks ago and I would like to congratulate the Wisconsin Central on their successful bid for this.

The Australian Tasmanian railroad had a length of about 500 kilometers and the gauge was 1.067 meters or U.S. three foot six. When we inspected the road, the local railroad had no inspection cars so they borrowed this from the local historical society. That's how we made our track inspection that particular day. This is, again, three 3 foot six.

They do have hi-rail vehicles for the inspection. This was the track inspector's vehicle. This next one was the section truck with a dump bed on it. This particular railroad in Tasmania serves the northern ports and runs on an elongated cross down to the southern capital city of Hobart. It starts out of Burnie and runs along the north shore of Tasmania. This is similar to some of those areas in the United States where depending upon the storm conditions, and depending upon the high tide conditions, and depending upon the winds, you have waves breaking up on your track.

On this particular stretch was a piece of tangent approximately seven kilometers long. It was the longest piece of straight track on the railroad. The railroad was 90 percent welded rail and 60 percent of it was steel ties. Steel ties were inserted on the mix. For the wood ties it was mixture of subplated and nonplated areas. It ran across what they call those dog ear spikes which is the elastic bent-over spring spike. The rail that we saw was a mix of 80 and 82 pound rail. It was considered the big rail.

This was a typical road crossing on the island. This was one of the local trains getting ready to leave out of the station at Burnie. All of their units are six axle, 2,000 horsepower. As you can appreciate, the six axle are of two different styles. One had a rigid center axle and the other style had a very flexible truck underneath it. Talking with the local people they had quite a bit of problems with the rail and rail wear on the curves.

This was a particular meet that we had at the holding yard and shows some of the log cars that they use. Basically they have gone to a basic flat car with either a log rack on it or container rack on it. They do have a pretty unique system of car utilization by basically just changing out the top connection for whatever particular purposes they have.

This was one of the bridges they had. The sign out there said 3.6 meter clearance. As we all know it doesn't matter how many signs you put out there, you are still going to get somebody that can't read or thinks that their truck may be just a little shorter than what the sign is. Underneath the bridge had been hit a couple times.

This photo is of the through-truss taken on a foggy morning. This particular bridge had just been replaced the weekend before we got there. It was done as a unit to the side and then they came in, took it out, and set the new one in place.

In closing, what I would like to reinforce is there are many opportunities out there in privatization. They are looking to privatize for cost reduction. However, there are opportunities for improving safety and there are also modernization needs. There are also opportunities for partnerships both with local contractors and with the major manufacturers throughout the world.

Some the challenges that you find if you get involved in this are the cultural difference, and especially the language. The language can be overcome with a little bit of education. However, the cultural differences sometimes tend to take a long time to get used to.

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I thank you very much for your time this morning. (Applause)

Mr. Sensing: Thank you very much, Chris. Willie Benton will introduce the next speaker.

Mr. Benton: Good morning. It's my pleasure to present our next speaker. He is Mr. Ike Scott, president and CEO of Scott Bridge Company. Ike's family founded and has owned Scott Bridge Company since 1933.

Ike graduated from the Georgia Institute of Technology in 1974 with a Bachelor of Science degree in civil engineering. He is a registered professional engineer in the State of Alabama. In 1995, he was appointed by Governor Bob James to chair the Alabama State Board of General Contractors.

He is chairman of the board of directors of Lee Scott Academy in Auburn, Alabama, a member of the board of directors of the Colonial Bank and is also a deacon in the Covenant Presbyterian Church in Auburn. Please join me in welcoming Ike. (Applause)

EXPLOSIVE REMOVAL OF BRIDGES

Ike Scott

Scott Bridge Company

Thank you, Willie, and my thanks to the American Railway Bridge & Building Association for inviting me to come out here and talk to you about a subject that we have become very familiar with over the last several decades.

Without further ado, pictures are worth 1,000 words so let me roll some video that will whet your appetite a little bit for my subject.

This video was taken of an old highway span in Alabama back in the 1960s. Since that project was done in the early 1960s, we have used that many, many times on highway bridges.

However, my subject this morning is going to focus on the specific use of shape charge explosives on old bridge trusses during the installation of a new spans within the track time allowed. For over 25 years, our company has used explosive shape charges to remove steel trusses. As you can see in the previous video, some of which were highway bridges and later bridges since 1991 or railroad bridges, we have found a way to successfully use it.

I notice that the title of your conferences which I very much enjoyed is Meeting the Challenges of the 21st Century. I would suggest to you that we can meet those challenges by not forgetting the methods that we have used in the 20th century, but by looking for new ways to use them. Subsequently, we don't necessarily have to reinvent the wheel.

In 1991, we were invited by Norfolk Southern to bid on the Lauden, Tennessee, rail bridge project. This project was approximately a 1,900-foot bridge. The opportunity there presented itself to use the shape charges. Previously on numerous removals that our company had done the standard removal process was either a float out or a roll out and then rolling the new span in or floating the new span in or possibly depending on the size of the truss, removing it with large cranes or a pair of cranes.

However, this particular location offered some site conditions that warranted a different method. Across this 1,900 feet, there was the channel which met the minimum core requirement for depth, but beyond that the water got very shallow. In fact, there was a small island in the middle. So whereas some of the ten approach spans which were 150-foot deck trusses could have been floated out and falsework built and rolled out, it couldn't have been done on

all. So we decided, having had numerous successes using steel shape charges to remove the steel trusses, to utilize this during the on-line replacement of the span.

This approach proved to be very, very successful throughout that project. The major span that you saw in the video across the channel was the new span floated in. The old span though was shot down. This saved a tremendous amount of falsework on barges and a whole different float out operation, additional tugs, and numerous equipment.

Since 1991, and the completion of the Lauden project in 1993, we have used the shoot-down method on approximately 11 additional spans on three or four additional river projects for Norfolk Southern in the southeast.

There were advantages and disadvantages as there always are. The first advantage of a shoot-down method is cost savings. Number one, we believe and our experience has shown that there is at least a 50 percent savings in the cost of the demolition which, of course, is passed on in our competitive bid to get the job.

There is also an overall project time savings. When you are shooting down, you don't have to take time to build the falsework and then move it for multiple spans. You don't have to take the time to bring additional barges in and build falsework on them. Then, of course, if you choose that method and you float an old span out, you still have to take it down. You still have to disassemble the spans so there is a tremendous time saving as far as the overall length of the project.

During the outage itself, the time that it takes to cut and place the explosives and drop the span is about the same as floating out or rolling the span out.

Other advantages we believe would be safety because simply we have less manhours out there and less exposure to our employees in manually or mechanically cutting the spans down.

In this operation of shoot down and then roll in hydraulically or I guess you call it let down some of these spans that you see, we have them suspended above the truss to be removed so we are actually either rolling in or lowering. We have a tremendous amount of redundancy. We are not dependent upon any large cranes or big barges. If the possibility came that a major piece of equipment would go down, your track would be out for a significant amount of time until it could either be repaired or another crane brought in.

The only major pieces of equipment involved are the hi-rail hydraulic cranes and we always have at least two. We have a back up for every part of the system in this procedure.

The use of explosives are not for every location. If you are in a metropolitan area, it can still be used, but you need to do a good survey, which we always do, of surrounding property and then judge what the impact would be on the public or businesses in the area.

On the film you just saw, there were six spans across the Chattahoochee River in Columbus, Georgia, right next to the mills and office buildings. Well, I am proud to say we didn't crack any windows.

Other disadvantages are there are times if there is heavy navigable traffic, where the Corps might not want to give you the time to remove the span from the water. So far we have not had that happen because when the span as you see it is shot down, the bottom cords are shot and it doesn't really take very long for our barge-mounted lightweight crane to go in and pick these pieces out of the water or as we did in Columbus. We picked it up in sections from a hi-rail crane on top of the bridge without having to have any river equipment.

To go into a little bit more detail about how we do this specifically with the charges, I want to show I you some slides.

This first photo shows the plunger if you want to call it that. Immediately next to it is the shape charges and then a roll of primer cords.

In the lower left-hand corner you can see the shape charges. You will see it in on a video section that will follow these photos. Shape charges are not anything new. In fact, they go back to the 1920s. After black powder had been used a lot in World War 1, there was a scientist named Monroe who came up with the Monroe effect of using RDX powder in a conical or

V-shaped copper tubing. The effect of this high-powered RDX powder when it is ignited is it causes such a hot stream of gases and particles that as they collide it is directed via the V that the tube is crimped into. That hot gas and those particles explode at such a high rate of speed that it will actually sever the steel. It will cut it clean.

If you have ever seen this process done, you can look at the end of the steel and you would think it was done with a laser. In fact, that's exactly what you have created is a sharp cutting edge. If you took one of these shape charges and put it up against a glass wall, it would actually sever the line where the shape charge is before the copper fragments that come off would break the glass. It happens that quickly.

The shape charge that we use is purchased in ten foot lengths. It's a soft copper tubing and that copper tubing is densely packed with RDX powder. RDX powder came from the military. It was one of their favorite powders because it was field safe in that a 30-caliber round of ammunition would not set it off. So the only thing that is going to set the RDX off is a blasting cap. On all of our shoot downs only one blasting cap is used.

I'll now give you some other information about the RDX and the shape charges. It generates over 2,000 degrees when it first explodes. We use about 600 grains of powder and that 600 grains will cut up to a three-quarter inch plate of steel. It doesn't actually have to cut it all the way through because if it cuts it close then the dead load of the span itself will sever it the rest of the way.

We have used up to 3,200 grains depending on the size of the cord members that are to be cut.

Here you see the primer cord coming out of the end of the copper tubing. Now, each copper tube is purchased in ten foot lengths and then it is cut to fit.

The first thing we do is analyze the truss that we are going to shoot down. That analysis tells us, first of all, how much of the flanges we can cut away. Then the remaining vertical plate in the bottom cord is analyzed for its thickness. That determines the grains that are necessary and, of course, the height of the web of that cord is what determines the length that we cut the shape charges to. Then there's a shape charge, a vertical piece of copper that has been crimped into a V and placed on each side of the steel plate to be cut. However, it is not put right up against the steel. If you were to place the copper shape charge with the V pointed towards the plate and you were to put it right up against the steel, it wouldn't work because that doesn't allow the time for it to generate the gases and for the particles to explode the steel. So it has to be backed off about three quarters of an inch.

There are black spacers that you see taped onto the copper and that's exactly what they do. They actually space it off with the steel. Primer cord comes out of the top. There is an RDX booster stuck down in the end of the top end of the shape charges. The primer cord then leads up to the top of the bridge. Ultimately we end up with four pieces of primer cord; one for each bottom cord of the truss, and one for each of the top cords. Those four are put around one blasting cap.

The last thing we do then is hook up to the blasting cap with our electric lines which go back some 200 or 300 feet to the plunger.

Up until that time it is totally and completely safe. Then we make the connection just within seconds before we ignite the span.

This was in Columbus. We have opted to bring the span in. It was preassembled in the factory and we brought it in by rail car. We rolled it in underneath our towers, picked it up with center hole hydraulic jacks and raised it into place to give enough clearance. We removed the track and the ties prior to shoot down.

What we have done here is shoot the bottom cord all the way across at the verticals. We have only shot the top cord at the end post. The reason for that is the water here was very shallow.

In the next photo we see after it goes down, it hits the water and the smoke is still clearing. You can see it barely sitting there in the water about six feet deep. So a major part of the truss was standing then. We go in cutting towards the top out and then we pick it up with hi-rail cranes.

Now, just following that operation portion of the shoot down is the lowering in of the span with the hydraulic rods. That whole operation took about 12 hours.

We have to be ever more careful about hazardous conditions and the hazardous effects of lead. Most of those old spans that we shoot down have some degree of lead paint still on them. We have to be very careful in protecting our employees and meeting the safety requirements which we are very keenly interested in doing.

The employee who will be doing the cutting typically will have four to six cutters. He is wearing a tie back suit that protects him from getting any lead on his clothing. He has a respirator over his face providing pure, pumped fresh air to him that has gone through a filter. Of course, he is wearing a life jacket as all employees out over the water do, and he has a safety harness.

The blue thing on his back is a battery pack for the fresh air pump that forces fresh air to his face. You can just barely see the pump on his right side. These men all wear monitors and after the operation is complete the suits, monitors, the wash station where they go and wash their hands and the wash water and everything goes in hazardous waste room. It is ultimately disposed of by a professional company.

This is a single-deck truss bridge in Haleyville, Alabama. This shot was taken from the top looking at the end. You can see the span being held there with the hydraulic jacks and all the thread rods.

These last two photos are of the span at Lauden, Tennessee. It was the first one that we did for Norfolk Southern. That was the navigational channel pier and the span and the pier next to it is the one that you saw shot down. The photographer just happened to catch that one perfectly. There were many people taking pictures, however, that's one of our favorites as it makes quite a statement.

There it is hitting the water.

(Whereupon there was a video presentation with a commentary as follows:)

This is the Haleyville project in north Alabama that we completed last February. There I am holding a short shape charge because that shape charge went on an I-bar. The black spacers are holding it against the wood. You see the primer cord coming out of the top. You can see the rubber bands we used to actually strap it to the side of the steel to hold it in place.

Here I am holding the pear-shaped charges. They go on both sides of the cord member in the bottom of the truss. The flanges of the bottom cord have been cut away so that it will fit snug against the web. There, again, is the plunger.

Here our cutters are cutting away the top cord connector to the end post as it is unnecessary to the integrity of the truss under dead load. That is a W-section that we will set out with our hi-rail cranes.

Here the men are preparing the bottom cord by cutting away the flange and cutting a hole in the web so they can stick the two copper tubes down inside the web of the cord.

This is our explosives expert. We don't do this ourselves. Mr. Ron Wood shown here with Explosives and Diving out in Florida is our expert on this project. Here we are lowering the charges down. The employee, secured off there with his harness to the safety line, is strapping the copper tubes to the cord.

There it is strapped now. There is a hole in the bottom. We cut out the center so the copper tubing will go down on both sides and is then strapped together.

There is the land line back to the plunger. It goes out to the capacitor and it's getting ready to shoot.

At this particular location, I don't know how else we would have done it. There was really very limited space with the highway bridge next to it. It was one of the only ways, we think, that it could have been done under some pretty tight track considerations.

This method is not for every bridge site, but we have found a way to use it successfully in the last few years. Many of the bridges in our area have rock foundations and massive piers. NS, CSX, and a number in our area have found it reasonable to replace the superstructure and just rehab the substructure. Most of these projects are just that.

Where the old stone piers have good integrity, they may require some grouting. They may require a new cap encasement of which we do a lot, but as far as the substructure is concerned, it's basically sound. However, the superstructure has seen its day. So this is a method that is not for the faint hearted, but it is very safe and done appropriately and well planned, works well. We believe this has saved our customers money over the past few years.

I was hoping with my presentation that the interest of it would keep you here. I was asked to send you out with a bang. So I will do that now and ask the gentleman to roll the video. I thank you for letting me be here today. Thank you. (Applause)

Mr. Lileikis: We would like you all to stay around here for a little bit if you would, please. We want to go through some final closing ceremonies and go through the opening up of our new organization. So if you all stick around for a little bit, we would really appreciate it.

Phil, would you like to come up here, please.

President Ogden: Since the AREA will not be conducting another business meeting since AREMA has been voted in by the membership of the three or four organizations that are going to merge into one organization for the future, we want to take just a minute or two and recognize the five outgoing directors. I would also like to present them with a plaque as a sign of our appreciation for the work that they have done for our organization over the past couple of years.

I would like to begin with recognizing the following directors who served on the board: Mr. Larry J. Anderson, Illinois Central, 1995-1997; Mr. John Clark, CSX; Mr. Gene Riley, Union Pacific, 1996-1997; Mr. Richard Keller, Montana Rail Link; and Mr. Gary Woods, Norfolk Southern, 1997.

We are not sure if any of them are here. If they are, I want to take this chance to recognize them. Thank you.

President Russell: I also would like to recognize the board of directors of the Roadmasters Association who have worked so hard over the years and really supported me. I will call them up by order of their office and please hold your applause until we have them all presented.

They are as follows:

Mr. Ron Poulsen, senior vice president. Had the Association continued, Ron would have automatically ascended to the office of the president this year. However, as Jeff Andrichik and Mr. Ogden will talk later, I think there are some new things in store for Ron which are going to be very challenging.

Mr. Darrell Cantrell, second vice president. Darrell has always been the motivator of our group. I am going to miss sitting around board meetings and having him keep things lively. Darrell, I think you also have some busy work ahead of you. Thank you very much for your support.

Mr. Reuven Shiloh. Reuven always kept us on the straight and narrow and made sure everything was done by the book and carefully analyzed before we made any decision and I really appreciate that. Thank you, Reuven.

Mr. Dwight Clark. Dwight always had a strategic plan for us looking out for five years. I think that is something the new organization will want to adopt if they haven't already done so. We had a plan, we had a vision, and he always kept us in line with the strategic plan. Thank you.

Mr. Thomas Long. Tom is the guy who has been trying to coordinate and round everyone up for this year's presentations. He worries to death and did a hell of a good job. I appreciate it, Tom.

Mr. Joe Riley. Joe headed up our training committee within the board of directors. He and his group have worked their butts off and have done a fine job. Here again, I think in the future with the new association, you have a lot of work ahead of you.

Mr. Andy Sensing. Andy is the guy who can work under pressure. Here, again, he was our program director this year. Congratulations and a special round of applause to you for this year's program. (Applause) Thank you, sir.

Mr. Dave Griffith. Dave is quiet, always there, always has a good idea that is well thought out before he speaks. I think that must be something that is ingrained in your part of the world. Thank you very much.

Mr. Christopher Dodge. Chris has given us an eye towards the shortlines and the regionals. This is sometimes something we forget as we come from the larger roads. He brings the ideas to look to the future. That's where these people are going to need the help. The larger roads have their standards and procedures, but they look to us to provide other guidance. Thank you, Chris.

Mr. William Ross. Bill is the snow man. Here again, you get a new perspective when you have people from Canada to help us out and share their problems and concerns and make everything on an even playing field across the North American continent. Bill, you brought a lot to us and I thank you.

Mr. Bob Hunt. I think the further east you get, the more quiet they get. Bob is a very good man and has been very supportive over the year. I know you weren't on the board that long, but we appreciate your contribution and your hard work.

Mr. Bob King. Bob served us very well. He gives us a perspective, again, from a combination of North American railroads here in the United States plus the Canadian aspect.

Mr. Gordon Basra. Gordon had to leave because of flight arrangements, but he has supported and participated in the board during his short tenure as a director.

Mr. Bob Davis. Bob is out in California with the Union Pacific as they had some problems this week. Bob, if you remember, is kind of a small man about this big. He has always been our sergeant of arms. He is the guy that we always had collect the surveys at the door. You couldn't get out unless you gave it to him and there wasn't anyone who was going to try to get out past him.

Mr. Pete Murgas. Pete is our financial wizard. Over the last year with the merger, when we went through a lot the expenses that we hadn't anticipated, we got down in the dumps financially, but through his good management as treasurer we got by the skin on our teeth, literally.

That is our board of directors. We sure appreciate it and have a good day. (Applause)

Mr. Lileikis: I would also like to take this opportunity to recognize all of the people on the board of directors of the B&B Association. Again, if you would please hold your applause until all have been introduced.

They are as follows:

Mr. Bob Carter, senior vice president, Burlington Northern Santa Fe. Bob is also in the precarious position where he would have been the next president of the Association.

Mr. Dave Franz, junior vice president. Dave has been very instrumental in putting together all aspects of the merger as one of the representatives of the B&B Association.

Mr. Jimmy Neece, junior vice president, CSX. Jimmy is responsible in putting our seminar packages together.

Mr. Don Lewis, our treasurer, is also a past president. Don is with the Illinois Central.

Now for our directors:

Mr. Pat Barrett, Burlington Northern Santa Fe; Mr. Dick Dummar, Union Pacific; Mr. Willie Benton, Norfolk Southern; Mr. Bill GeMeiner, Union Pacific; Mr. Steve Ross, Conrail; Mr. Preston Sargent, Union Pacific; and Gordon Davis, FRA.

The other two directors of the association who are not here today are:
Mr. Dave Cook, Montana Rail Link; and Mr. Richard Calhoun, CTE.
This is our the B&B board. (Applause)

At this time, Wayne and I would like to take a few minutes of your time before we continue on with where we are going and please ask Barb Marlow and Pat Weissmann to come up. We would appreciate it.

Pat is the secretary of the both organizations and has basically kept Wayne and me and countless numbers before us on the straight and narrow. Barb has always been her trustworthy assistant.

We have a couple of certificates here for Pat and Barb and I will read them to you. It says, "Certificate of appreciation awards to Barb Marlow and Pat Weissmann for your continuous support and leadership of both Associations presented by the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association. It is signed by myself and also by Wayne."

We appreciate your support immensely and we can't tell you how much we thank you for the work that you have done for us. We just want you to give as much effort to the new association as you have given to us. Thank you. (Applause)

Mr. Koff: This is a time that is usually reserved for the incoming president of Roadmasters to take just a few moments and reflect on the year's activities.

I am honored to be able to spend just the last few minutes here at the conference to take a moment and recognize the efforts of Wayne Russell over the course of the year. He has led this organization and has done an excellent job. We have had a good conference. I think it's fitting that we take a moment to congratulate Wayne and his board on an outstanding conferences. I think they have done a remarkable job.

It has clearly been a busy year for him and for his board of directors. They had a conference to get together and coordinate with the REMSA show which is always a little more of a challenging situation, and it has been a little extraordinary in demands because of the merger discussions that began almost two years ago. Wayne stepped up to the plate.

During my presidency, we appointed a group of men to lead that effort and Wayne very unselfishly jumped in there and agreed to participate as a lead on that. He was rather aptly supported by Darrell Cantrell and Ron Poulsen.

I would like to say, Wayne, thank you again for your dedication, your unselfishness of your time and your leadership in this organization. We had the right man at the right time and we thank you for that.

Wayne, if you join me up here, I have a certificate to award to you recognizing your year of service as president.

President Russell: Thank you very much. Those were awfully kind words, but in reality it was very, very easy when you have a group of people to work with like I did. Whether it was the board of directors, Pat Weissmann, Barb Marlow, the B&B board, or the REMSA board, everybody knows what to do. So all you have to do is call and ask and they will guide you in the right way. So it was a very easy and pleasurable year. Thank you. (Applause)

Mr. Bradley: We would also like to thank Joe Lileikis for his leadership this year. It has been a very challenging year with it being a show year. We also, as an organization, have seminars and Joe participated in those even though he was president. The merger took a lot of hard work and I am sure there were a lot of painstaking evenings that everybody on the committee put in. As president, Joe was the B&B leader on the merger committee and he did a superb job along with all the other association representatives.

One of the things that you will be seeing that Joe was is a catalyst on, is a bridge inspection manual. With all of that, I don't know if he ever slept. It's pretty hard in these days with the downsizing of all the railroads, and the mergers, to take this on and go with it. I really have to congratulate Joe and his leadership this year because I don't think there has been a challenge that any of us have had in the past like there was this year.

Joe, if you would come up, I would like to give you your certificate.

Mr. Lileikis: I would like to second what Wayne said, really the challenges put before us were, for the most part, easily overcome from the standpoint that we have tremendous boards and we have a good working relationship with each other. We actually had very smooth meetings and we did accomplish a lot during those meetings.

We had a lot of people who stepped up to the plate from outside of the board who also contributed a lot. So without their help, obviously things on my end would not have been as easy. So I want to thank them as well. Thank you. (Applause)

President Madderom: It is my extreme honor as president of REMSA and on behalf of REMSA to present the presidents of the Roadmasters and B&B associations with plaques to commemorate their terms of office. So I have plaques for both Wayne and Joe. We are going to ask them to come to the podium.

These two men have probably served like none of their predecessors because not only have they had to manage the affairs of the associations, but of course, with the consolidation going on they had extra duty.

REMSA has not been immersed in these issues to any great extent, but we know what is involved. We understand that. We have been impressed both by Joe and Wayne and their respective memberships. I am sure we are all grateful for these two fine leaders who have headed up these associations.

I have the privilege of presenting Wayne and Joe with plaques that capture REMSA's expression of thanks for the superb cooperation and support extended to REMSA particularly this year in the show year and in the way that they have conducted the affairs of their associations.

They have ensured that the disciplines represented by their associations will go forward under the new banner of AREMA.

Wayne and Joe, thank you. Good luck to you both. (Applause)

I will now turn the podium over to Jeff Andrichik.

INSTALLATION OF AREMA OFFICERS

Mr. Andrichik: What better way to close this historic joint conference program than to allow each of the four associations that make up AREMA review the legacies of their proud pasts and announce the new beginning of the one combined association — AREMA.

Joe McGinley of Conrail, Bruce Willbrant of Amtrak, Nate Smith formerly of the Milwaukee Road, and John Horney of Carter Burgess will highlight the historical perspectives of the four association while Phil Ogden of the Norfolk Southern will review the status and future of AREMA.

We will then introduce the new AREMA board. That will be followed by remarks by both the B&B and Roadmasters Associations.

Mr. McGinley: Good morning. I am Joe McGinley from Conrail and chairman of AAR Committee E signal systems.

In 1885, the railroad telegraph superintendents of the major railroads created the Association of Telegraph and Telephone Superintendents. Ten years later on March 11, 1895, at a meeting held in the office of the Railway Review in Chicago, W.H. Elliot, H.D. Miles, W.B. Turner, W.J. Gillingham, Jr., and V.K. Spicer formed what that night became the Railway Signaling Club with Mr. Gillingham as the first chairman.

The second meeting was held on April 9, 1895, at the office of the W.B. Turner, then signal engineer of the Chicago and Western Indiana. Mr. Turner read the first paper entitled, "Interlocking with Relation to Track and Traffic." The committee went on to create a code of rules governing the operation of interlocking plants and continued to meet and give papers such as; Electric Circuits at Interlocked Highway Crossings, and Features of Interlocking Construction on the Michigan Central, just to name a few.

In 1919, the Railway Signaling Club became the Signal Division and the Railway Telegraph Superintendents became the Telegraph and Telephone Section of the newly created American Railway Association.

In 1934, the ARA became the Association of American Railroads, or the AAR. The Signal Division was renamed as the Signal Section and the Telegraph and Telephone Section was renamed as the Communications Section.

In 1961, the Communication and Signals Sections merged to become what today is known as C&S Section of the AAR.

With the recent downsizing of the AAR, it became necessary for the technical committees to find a new home. In January of this year, a committee of AAR members, headed by Phil Abaray of the Union Pacific, was invited to attend a merger meeting with members of the AREA, the B&B, and the Roadmasters. By the end of our next meeting, a decision was made to join with the other organizations in merging into what will become AREMA. It was at this point that the committee of 9 became the committee of 12.

The C&S group sees many opportunities in this merger and our vision is to expand into a full range of railroad engineering support in the form of educational material and symposiums as well as standards. Thank you very much. (Applause)

Mr. Willbrant: Thank you, Jeff.

With the railroad standardization on the 4 foot 8 1/2 inch gauge in the middle 1880s when the southern railroads were converted from 5 foot gauge, the concept of the fully interchangeable North American railway network came to fruition, except for the short-lived "narrow gauge fever," which would largely play itself out by the end of the century except for the Colorado mountain area.

But to achieve mature development, this newly-integrated standard gauge network need a forum to develop and study recommended practices to handle the complex questions regarding the need for improved materials, designs, and procedures for railway tracks, bridges, and other fixed property.

At the suggestion of "Railway Age" magazine, a meeting was held in Chicago on October 21, 1898, to develop an organization to handle these tasks of advancing the scientific and engineering knowledge about the construction and maintenance of railways. This led to a meeting at the Iroquois Hotel in Buffalo, New York, on March 30, 1899, to adopt a constitution and establish a permanent organization named the American Railway Engineering and Maintenance of Way Association, which, of course, was later shortened to the American Railway Engineering Association. The first president was John Wallace, who was chief engineer of the Illinois Central. The new association enabled the resources and talents of the Railway Engineering profession to be pooled to help advancement for the benefit of the growing railway industry.

From its inception, the AREA dealt with many engineering challenges through standing technical committees, of which there were originally 14. Several of these 14, including committee 3, ties; committee 4, rail; committee 5, track; committee 6, buildings; and committee 14, yards and terminals; still exist with the basic names and functions continuously since 1899.

The tradition of the March technical conference began immediately, with the first one held March 14, 1990, in Chicago, to promote the exchange of information among professionals. The publication of AREA Bulletins also date from the very beginning of the organization.

Within just a few years, the technical committees had progressed to the point where it was decided to issue an AREA Manual of Recommended Practices, which first appeared in 1905.

Thus, in only six years, the AREA had grown into the form that has successfully continued until today, with the technical committees charged with keeping the Manual the vital, living document we have seen since that time.

It is interesting to note that in what are considered among the AREA's most productive and influential years, around 1910 - 1915, the membership in the AREA was less than 1500, less than half what it is today.

In 1919, the AREA entered into an arrangement with the American Railroad Association to share the headquarters staff of the AREA with the engineering staff of that organization. In 1934, the American Railroad Association became the Association of American Railroads, the AAR we know today, and the same arrangement with the AREA continued. During this period, the AREA remained fully independent, with the completely separate finances and officers. This made the end of this joint staffing arrangement in 1995 a legally simple one.

Since the founding of the AREA in 1899, the headquarters was located in Chicago, Illinois, until its move to Washington, DC, 80 years later in 1979. This move was prompted by the increased involvement of the federal government in railroad maintenance of way matters, especially the promulgation of the FRA Track Safety Standards in 1971. This move to Washington in 1979 coincided with a 100-percent turnover in headquarters staff in only a six-month period.

After 1979, the AREA grew in membership and achieved a new vitality with improved publication and conference quality, plus a new symbol adopted in 1981 to better convey its function in the contiguous railway network of the North American continent. An extensive effort was made at this time to more fully involve Mexico in the AREA. In 1984, an initiative took place to increase AREA involvement in rail transit, and the creation of Committee 12 was perhaps the most successful committee start in AREA history. High speed rail and short line involvement was also promoted.

Thank you very much. (Applause)

Mr. Andrichik: Thank you, Bruce.

Mr. Nate Smith will give us some historical highlights of the Roadmasters.

Mr. Smith: "Mr. President, fellow members, and friends. I am happy to be present at the 50th anniversary of the Roadmasters and Maintenance of Way Association of America which I am told is the oldest railroad organization in existence in this country. I also understand that yours was the first association in this country to initial standard plans and practices for track work."

Those were the opening remarks and the opening paragraph in the address by Mr. J.V. Newburg, chief engineer maintenance of way, New York Central System, at the 50th annual convention of the Roadmasters and Maintenance of Way, Tuesday evening, September 17, 1935, in Chicago. Mr. Newburg was president of AREA from 1932 to 1933.

There is much more about the history of the Roadmasters in the proceedings in 1935 prepared and presented by Mr. George E. Boyd, the associate editor of Railway Engineering and Maintenance.

Mr. President, fellow members of the B&B, Roadmasters, Communications and Signals, AREA, and guests, this is the 102nd annual conference of the B&B Association and the 109th annual conference of the Roadmasters Association.

It is a great honor and privilege for me to say a few words on behalf of the Roadmasters Association regarding its history and the merger of these three great and purposeful organizations to become AREMA, the American Railway Engineering and Maintenance of Way Association.

Each of those organizations has a long and honorable background in the design, problem solving, and maintenance of track and all railway facilities. Each has historically through conferences, seminars, publications, and just plain talking to each other, had a primary goal in improvement — better track, better bridges, better equipment, better methods, more quality work, better training of people, and doing the job safer.

The improvements and technological advancements made in the last few years are almost beyond belief, but it did not just happen. It is the result of hard work that started many years ago and cooperation between these organizations and REMSA.

Recognizing the benefits from discussions and the sharing of information and solutions to maintenance problems and situations, several people did something about it. The result was the Roadmasters and Maintenance of Way Association.

This organization was organized in 1882 with the first general meeting in Chicago in June, 1883, with 61 roadmasters representing 24 railroads present. Today the membership is over 1,600. I don't know how many railroads there are as it keeps changing.

The first elected president was Isaac Barnett of the Rock Island.

I met my first roadmaster about 50 years ago in July of 1947. It was on a 100-mile rail relay program just getting started. I didn't even get to draw. I got the short straw and I had to go. I showed up at the jobsite in western North Dakota and asked if the roadmaster was present. A gentleman about 6'4", just about anyway you want to look at him, stuck out his hand and I looked at one of the biggest mitts I had ever seen. Well, we shook hands and a bit later he said, "Hey, young fellow, what's the cant on these tie plates?" I paused and said, "Well, sir, as soon as I figure out what a tie plate is, I'll figure that out for you." (Laughter)

Folks, I was his apt pupil not only on that day but for the next several years. That 6'4" didn't stop with the physical size; it extended to his desire and willingness to share his experiences in problem solving and getting the job done, at times with a great deal of emphasis, with his foreman, and on occasion with young engineers.

There are many places where training, cooperation, and education processes take place. However, there is no better place or opportunity for the leadership and direction for this to take place than from AREMA. We have one of the greatest opportunities and challenges for the future of railroad engineering and railroad maintenance. Why don't we just do it? (Applause)

Mr. Andrichik: Thank you, Mr. Smith, for that sincere and insightful synopsis.

Now John Horney will give us a B&B historical perspective.

Mr. Horney: Thank you, Jeff.

Here we are in September of 1997 voting to merge four significant railroad associations. It was in September of 1891, 106 years ago, that a group of railroad men voted to organize the American Railway Bridge and Building Association.

When this Association was first organized, it was named the American International Association of Railway Superintendents of Bridges and Buildings. The creative initiative for our association is credited to a Mr. Owen Travis with the Iowa Central Railway. On June 25, 1891, Mr. Travis addressed a circular letter to heads of railroad departments asking their views on the feasibility of organizing a national association. There were nearly 100 responses to his letter with an overwhelming favorable opinion.

From recommendations of those responses, St. Louis was the city selected to hold the first meeting on September 25, 1891. Thirty-six men attended. Twenty-four were not able to attend, but these 60 men represented 40 railroads and became the charter members of the association.

It was during this first meeting that our constitution and bylaws were adopted. It was decided to hold an annual meeting for the dissemination of ideas through the reports of committees on selected subjects of mutual interest to the members and various railroads.

The annual conventions of this period were generally scheduled to run from Tuesday through Thursday thus allowing a three-day weekend on each end for traveling.

During the Depression, annual meetings of the association were suspended from 1931 through 1933 due to the poor financial condition of the railroads. When the annual conferences began again in 1934, it was the beginning of a stretch of 43 consecutive meetings held in Chicago.

In 1943, war-time conditions began to affect the association and the convention that year was limited to two days.

In 1944, the convention was canceled due to the restrictions imposed on the conference by the Offices of Defense and Transportation. In 1945, when these restrictions were lifted, a one-day meeting was held in Chicago. Now the math works. Our Association is 106 years old, yet this is our 102nd annual conference. No conferences were held in the years 1931, 1932, 1933, and in 1944.

The 1946 convention was the first full three-day meeting held by the association since 1942. This was the first time that the meeting was held concurrently with the annual conference of the Roadmasters and Maintenance of Way Association of American. In conjunction with that particular meeting, the Bridge and Building Supply Men's Association and the Track Supply Association held a joint exhibit which exceeded the scope of any previous exhibits held by either of those associations.

On reflection on the success of that particular meeting, the executive committee voted to hold the 1947 convention concurrently with the Roadmasters, a practice that has continued to prove beneficial to both organizations.

In 1979, the first time in 49 years, the Association held its annual conference away from Chicago. Meetings were held at the World Congress Center in Atlanta, Georgia, and REMSA '79 was held in conjunction with that meeting. The success of this meeting prompted REMSA's decision to hold their shows in the fall locations away from Chicago. The success of the REMSA shows held outside of Chicago every four years prompted the B&B and Roadmasters to plan meetings away from Chicago every other year.

The first non-exhibit meeting held outside of Chicago was in Kansas City, Missouri, in 1987.

In keeping with the original intent of the Association, the B&B offered our first seminar to our members in 1991. We have used the revenue of these seminars to grant two $1,000 college scholarships a year to dependents of our members.

In observance of this 100th anniversary, the B&B Association returned to St. Louis, Missouri, for the 1991 annual conference. St. Louis being the city of its inception.

The first time the history of our association was presented was at a conference at the tenth annual convention. The last time our history was presented was at our 100th year anniversary in 1991. This is the last time the history of the American Bridge and Building Association will be presented.

Throughout its history, our association has been fortunate to have had dedicated individuals who have given of their time and effort to present the many reports during our conferences.

Many dynamic changes have occurred during our 106-year history, but the basic reasons for forming the association still exist — the need to exchange information and to find solutions to problems that confront the railroads are as important today as they were in 1891. However, we no longer have 40 railroads. Like the representatives of our first meeting, our new association, AREMA, has the same goals in its constitution as each of the four associations that it will replace.

It will be the responsibility of the members of AREMA to carry on traditions that have been passed on to them to remember how the birth of AREMA was created, to let the whole represent the sum of its parts, and to recall in pride the roots of its birth the next time the history of AREMA is presented at one of its future conferences. (Applause)

Mr. Andrichik: Thank you, John, for your thoughts and highlights. Also thank you, Joe, Bruce, and Nate for yours as well.

Now we have Phil Ogden who is going to tell us all about AREMA.

President Ogden: The AREA, Roadmasters, B&B, and C&S Associations all have a long and rich history filled with many evidences of success. These organizations have existed for 100 years or more and each has made many contributions to the rail industry.

For all of the members and others who have supported these organizations, we say thank

you. We are indebted to you for your support to the associations and, more importantly, we are indebted to you for the services these associations have provided the rail industry. In meeting the engineering needs of this industry, you have set the professional business bar high. It is now our job through AREMA to continue the process of raising this bar.

Considering all the evidence of success we could talk about such as the technical manuals, training seminars, recognized practices and standards, and there are many more, why change? I could stand here and list all the reasons your merger team came up with, but I think you know most of them. If you stop and think about it, though, it is really simple. We must change because an industry that you have served so well for 100-plus years is not the same industry as we move into the 21st century.

The theme of this conference has been Meeting the Maintenance Challenges of the 21st Century. This is also what this merger is about. As the representatives from each of the associations came together as a team and began to focus on the type of engineering organization we needed for the next century, AREMA was the answer.

With Monday's vote, you have also stated we need to change and get in step with the rail industry of today. The status quo is not good enough any more. You know that. You have all experienced the same types of challenges in your businesses whether it be on the railroad or the supply side. Keep the status quo and you get left behind at the station.

Each of the associations that are coming together to form AREMA have in their own ways built an excellent foundation for all of us to get together and share information that can be used as part of our continuous improvement process. We will use all these foundations to build upon for the start of AREMA.

As you know, there will be five functional groups each headed by a vice president. These groups are track, structures, C&S, passenger and transit, and engineering services. With this type of structure, we believe we can better serve the needs of all the technical committees which are the heart of our manuals and the nominating committee. The nominating process for board members is set up to function where you, the members, will create the slate of officers for future boards. It is more of a grass-roots approach compared to our previous process.

Another important aspect of AREMA is that for the first time we bring all of the different engineering disciplines under one umbrella. It could be compared to what our customers call one-stop shopping.

Let me conclude by stating that for AREMA to be successful we must use the evidence of the past success as the foundation to build a new association. We have to measure up to your expectations. I believe we can. We will need the same support from you, though, that you have given the past associations.

If the rail industry in the next century needs an organization like this, and I believe we do, we will survive only by meeting your expectations and the demands of the industry. I believe AREMA can do this. I believe AREMA can be a world-class organization, but only if this is it what you want it to be. All of us, the railroads, the rail suppliers, contractors, and consultants are willing and ready to support this effort.

I think you have assembled a great group for your first board. There is a lot of experience here and a lot of talent. Our plan is to get on with the work that is before us with a short meeting this afternoon for organizational purposes. We have a conference call scheduled for October 2nd, which is the second day after the organization becomes official on October 1st. There is a board meeting on October 16th, and another one scheduled for December 15th.

So we plan to get started with the business at hand. If you will support the organization like you have done in the past, then I think AREMA can be the organization that we all want it to be to serve the industry in the next century. Thank you. (Applause)

Mr. Andrichik: It is now pleasure to introduce the first AREMA board of directors. If you would, please hold your applause until all the directors have been introduced and they come up to the front for their introductions.

President Phil Ogden, Norfolk Southern; senior vice president, Darrell Cantrell, Burlington Northern Santa Fe; international director, Lorenzo Reyes, FNM; and treasurer, Ben Dwinnell, SEPTA.

The rest of the board will be introduced by their functional groups:

For the track group, vice president, Ron Poulsen, HDR

For the directors, Walt Heide, Conrail; Dave Kelly, Illinois Central, Rick Richardson, Canadian National.

For the structures group, vice president, Don Lewis, IC; Ray Tallent, Norfolk Southern; Don Steele, Union Pacific; and Jimmy Neece, CSX.

For the communications and signals group, unfortunately none are available: Alvan Tom, Canadian National; Bob Nash, Canadian Pacific; Keith Holt, Amtrak; and Ken Bagby, Canadian National.

For the passenger and transit group, vice president Mark Walbrun, TranSystems,

For directors, John Cunningham, Amtrak; Mike Armstrong, Burlington Northern Santa Fe; Lyn Wylder, MARTA.

For engineering services, vice president, Bruce Willbrant, Amtrak.

For directors, Mike Roney, Canadian Pacific; Reuven Shiloh, Conrail; and Bill Thompson, Union Pacific.

For past presidents, Joe Lileikis, Amtrak; Jim Beran, JRB Engineering; and Wayne Russell, Burlington Northern Santa Fe.

Ladies and gentlemen, your AREMA board of directors. (Applause)

As Phil mentioned, there will be a meeting as soon as this ceremony is over in Room 4202. It will be approximately one hour. Thank you very much. Wayne and Joe, any final comments?

President Russell: I declare the 109th conference of the Roadmasters Association closed. Thank you all. (Applause)

Mr. Lileikis: I want to thank everybody for their attendance to this conference and the support of all organizations for as long as you have. We do need to thank all those who contributed to the amazing success of this conference as well as our thanks to all the presenters.

With that, this marks the conclusion of the 102nd annual conference of the B&B Association, but most importantly, it marks the final joint technical conference of both organizations. Thank you. (Applause)

(Adjourn)

Past Officers

	1891-1892	1892-1893	1893-1894	1894-1895
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	C. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-1896	1896-1897	1897-1898	1898-1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	W. O. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

Past Officers

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullen	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnson	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

Past Officers

	1934–1935	1935–1936	1936–1937	1937–1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938–1939	1939–1940	1940–1941	1941–1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary	. . . . .	. . . . .	F. O. Whiteman	A. G. Shaver
Treasurer	. . . . .	. . . . .	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942–1943	1943–1944	1944–1945	1945–1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

† To November 1, 1942 ‡ To February 1, 1943

	1946–1947	1947–1948	1948–1949	1949–1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950–1951	1951–1952	1952–1953	1953–1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

PAST OFFICERS

	1954–1955	1955–1956	1956–1957	1957–1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. H. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. VonSprecken
	H. D. Curie	E. R. Schlaf	T. M. VonSprecken	W. H. Bunge
	J. M. Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958–1959	1959–1960	1960–1961	1961–1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962–1963	1963–1964	1964–1965	1965–1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966–1967	1967–1968	1968–1969	1969–1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fuller	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	N. D. Bryant	J. S. Ellis	N. F. Lucas	W. H. Rankin
	A. R. Dahlberg	T. L. Fuller	W. L. Short	E. E. Runde
	H. F. Lucas	R. A. Youngblood	C. E. Wachter	T. A. Reynolds
	J. S. Ellis	H. F. Lucas	A. C. Jones	J. J. Ridgeway
	T. L. Fuller	W. L. Short	W. H. Rankin	J. R. Williams
	R. A. Youngblood	C. E. Wachter	E. E. Runde	J. W. Chambers
	V. D. Raessler	A. C. Jones	T. A. Reynolds	R. E. Frame
	W. L. Short	W. H. Rankin	J. J. Ridgeway	J. C. Hobbs
	C. E. Wachter	E. E. Runde	J. R. Williams	

	1970–1971	1971–1972	1972–1973	1973–1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	T. A. Reynolds	J. W. Chambers	R. K. Corbett	D. C. Gould
	J. J. Ridgeway	R. E. Frame	J. R. Iwinski	W. S. Stokely
	J. R. Williams	J. C. Hobbs	J. S. Pritchett	W. C. Sturm
	J. W. Chambers	R. K. Corbett	D. C. Gould	J. W. Davidson
	R. E. Frame	J. R. Iwinski	W. S. Stokely	C. A. Hughes
	J. C. Hobbs	J. S. Pritchett	W. C. Sturm	W. R. Hyma
	R. K. Corbett	D. C. Gould	J. W. Davidson	O. C. Denz
	J. R. Iwinsky	W. S. Stokely	C. A. Hughes	R. C. McMaster
	J. S. Pritchett	W. C. Sturm	W. R. Hyma	W. E. Brakensiek

PAST OFFICERS

	1974-1975	1975-1976	1976-1977	1977-1978
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin	J. R. Iwinski
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. R. Iwinski	W. C. Sturm
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm	D. C. Gould
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould	J. W. Chambers
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	J. W. Davidson	W. E. Brakensiek	J. W. Chambers	W. J. Gunkle
	C. A. Hughes	O. C. Denz	M. Noyszewski	W. E. Halley
	W. R. Hyma	R. C. McMaster	W. J. Gunkle	K. L. Wammell
	W. E. Brakensiek	F. R. Lindsay	W. E. Halley	J. Budzileni
	O. C. Denz	M. Noyszewski	K. L. Wammel	B. J. King
	R. C. McMaster	W. C. Sturm	J. Budzileni	J. G. Robertson
	F. B. Lindsay, Jr.	W. J. Gunkle	B. J. King	O. C. Denz
	M. Noyszewski	W. E. Halley	J. G. Robertson	E. C. Patterson
	Jim Payne	K. L. Wammel		W. S. Stokely

	1978-1979	1979-1980	1980-1981	1981-1982
President	W. C. Sturm	D. C. Gould	J. W. Chambers	W. R. Hyma
Sr. V.-Pres.	D. C. Gould	J. W. Chambers	R. C. McMaster	O. C. Denz
Jr. V.-Pres.	J. W. Chambers	R. C. McMaster	W. R. Hyma	J. Budzileni
Jr. V.-Pres.	R. C. McMaster	W. R. Hyma	O. C. Denz	J. M. Williams
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Pat Weissmann
Treasurer	W. F. Armstrong	W. F. Armstrong	W. F. Armstrong	W. C. Sturm
Directors	J. Budzileni	O. C. Denz	J. W. Davidson	D. A. Bessey
	B. J. King	W. J. Gunkle	C. M. Russell	J. N. Michel
	J. G. Robertson	W. S. Stokely	J. M. Williams	P. H. Saletnik
	O. C. Denz	L. D. Green	D. A. Bessey	O. D. Anthony
	E. C. Patterson	C. M. Russell	J. N. Michel	J. T. Kapp
	W. S. Stokely	J. M. Williams	P. H. Saletnik	D. J. Lewis
	L. D. Green	D. A. Bessey	O. D. Anthony	J. W. Davidson
	C. M. Russell	J. N. Michel	J. T. Kapp	H. J. Laga
	J. M. Williams	P. H. Saletnik	D. J. Lewis	A. S. Uppal

	1982-1983	1983-1984	1984-1985	1985-1986
President	O. C. Denz	J. Budzileni	J.M. Williams	D. A. Bessey
Sr. Vice President	J. Budzileni	J.M. Williams	D.A. Bessey	J. T. Kapp
Jr. Vice President	J. M. Williams	D.A. Bessey	J.T. Kapp	D. J. Lewis
Jr. Vice President	D. A. Bessey	J.T. Kapp	D.J. Lewis	R. A. Tallent
Secretary	P. A. Weissmann	P.A. Weissmann	P.A. Weissmann	P. A. Weissmann
Treasurer	P. H. Saletnik	P.H. Saletnik	P.H. Saletnik	J. M. Williams
Directors	O. D. Anthony	J.W. Davidson	T.E. Kuhn	B. T. Burns
	J. T. Kapp	D.J. Lewis	D.R. Ladner	J. J. Horney
	D. J. Lewis	T.E. Kuhn	R.A. Tallent	W. J. Semioli
	J. W. Davidson	D.R. Ladner	B.T. Burns	R. E. Fronczak
	H. J. Laga	R.A. Tallent	J.J. Horney	W. P. Cunningham
	A. S. Uppal	B.T. Burns	W.J. Semioli	J. H. Smith
	T. E. Kuhn	J.J. Horney	D.W. Brookings	E. Bond
	D. R. Ladner	W.J. Semioli	W.P. Cunningham	D. L. Steele
	R. A. Tallent		J.H. Smith	M. C. Walbrun

	1986-1987	1987-1988	1988-1989	1989-1990
President	J. T. Kapp	D. J. Lewis	R. A. Tallent	B. T. Burns
Sr. Vice President	D. J. Lewis	R. A. Tallent	B. T. Burns	J. J. Horney
Jr. Vice President	R. A. Tallent	B. T. Burns	J. J. Horney	M. C. Walbrun
Jr. Vice President	B. T. Burns	J. J. Horney	M. C. Walbrun	P. H. Saletnik
Secretary	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	J. M. Williams	J. M. Williams	J. M. Williams	J. M. Williams
Directors	W. H. Nelson	M. C. Walbrun	C. E. Thompson	W. H. Nelson
	J. H. Smith	S. Lipkus	H. L. Davidson	T. J. Parker
	J. J. Horney	D. L. Steele	J. A. VanHuis	R. C. Karsten
	M. C. Walbrun	C. E. Thompson	W. H. Nelson	R. C. Carter
	E. Bond	H. L. Davidson	T. J. Parker	T. V. Dunn
	D. L. Steele	J. A. VanHuis	R. C. Karsten	M. L. Bradley
	C. E. Thompson	W. H. Nelson	S. Lipkus	D. G. DeBerg
	H. L. Davidson	T. J. Parker	T. V. Dunn	D. F. Sorgenfrei
	J. A. VanHuis	R. C. Karsten	M. L. Bradley	J. A. Lileikis

	1990-1991	1991-1992	1992-1993	1993-1994
President	J. J. Horney	M. C. Walbrun	P. H. Saletnik	D. L. Steele
Sr. Vice President	M. C. Walbrun	P. H. Saletnik	D. L. Steele	J. A. Van Huis
Jr. Vice President	P. H. Saletnik	D. L. Steele	J. A. Van Huis	M. L. Bradley
Jr. Vice President	W. H. Nelson	J. A. Van Huis	M. L. Bradley	J. A. Lileikis
Secretary	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	J. M. Williams	D. J. Lewis	D. J. Lewis	D. J. Lewis
Directors	R. C. Carter	D. G. DeBerg	D. L. McCammon	R. W. Carter
	T. V. Dunn	D. F. Sorgenfrei	J. T. Creighton	C. W. Young
	M. L. Bradley	J. A. Lileikis	J. G. Bradley	D. K. Franz
	D. G. DeBerg	D. L. McCammon	R. W. Carter	J. L. Hostler
	D. F. Sorgenfrei	J. T. Creighton	C. W. Young	J. L. Neece
	J. A. Lileikis	J. G. Bradley	D. K. Franz	R. W. Kaye
	D. L. McCammon	R. W. Carter	J. L. Hostler	M. L. Johnson
	J. T. Creighton	C. W. Young	J. L. Neece	T. Rich
	J. G. Bradley	D. K. Franz	R. W. Kaye	D. E. Bartholomew

PAST OFFICERS

	1994-1995	1995-1996	1996-1997
President	J. A. Van Huis	M. L. Bradley	J. A. Lileikis
Sr. Vice President	M. L. Bradley	J. A. Lileikis	R. W. Carter
Jr. Vice President	J. A. Lileikis	R. W. Carter	D. K. Franz
Jr. Vice President	R. W. Carter	D. K. Franz	J. L. Neece
Administrative Director	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	D. J. Lewis	D. J. Lewis	D. J. Lewis
Directors	J. L. Hostler	M. L. Johnson	P. L. Barrett
	J. L. Neece	T. Rich	D. W. Cook
	R. W. Kaye	D. E. Bartholomew	R. C. Dummar
	M. L. Johnson	P. L. Barrett	R. L. Calhoun
	T. Rich	D. W. Cook	W. Benton III
	D. E. Bartholomew	R. C. Dummar	W. G. GeMeiner
	P. L. Barrett	R. L. Calhoun	R. S. Ross
	D. W. Cook	W. Benton III	G. A. Davids
	R. C. Dummar	W. G. GeMeiner	P. E. Sargent

CONSTITUTION

(Revised September 18, 1990)

ARTICLE I

NAME

Section 1. This Association shall be known as the American Railway Bridge and Building Association.

ARTICLE II

OBJECT

Section 1. The object of this Association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway structures and fixed facilities by investigation, reports and discussions.

Section 2. The Association shall neither endorse nor recommend any particular devices, trademarks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the Association in regular session.

ARTICLE III

MEMBERSHIP

Section 1. The membership of this Association shall be divided into five classes: Members, Life members, Associate members, Honorary members and Junior members.

Section 2. A member shall be a person in the railway industry (except representatives of manufacturers and/or suppliers of equipment, material or labor services) engaged in engineering, construction and maintenance of railway structures and fixed facilities; a person in the employ of a public regulatory body; a professor of engineering or architecture; a technical editor; a materials expert; a consulting engineer, or an engineer employed by a consulting engineering firm, engaged in the engineering, construction and maintenance of railway-related facilities; an engineer employed by a technical service or research and development organization; or an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this Association. Any person desirous of becoming a member shall make application upon the form prescribed by the Executive Committee, setting forth the applicant's name, address and practical experience. The applicant shall be recommended by at least one member of the Association to whom they are personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the Executive Committee, a majority vote being necessary in either instance.

Section 3. To be eligible for a life membership, an individual must have belonged to the Association for at least 15 years and in general must have retired from active employment due to age or physical disability. A life member shall have all the privileges of previous membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2 of this Article.

Section 4. Associate members shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to cooperate with members in the study and development of improved practices in the construction and maintenance of railway structures and fixed facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article, except that they shall be recommended by either a member or an associate member of the Association to whom they are personally known.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the majority vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any person in the Association membership whose conduct in any way diminishes the professionalism or prestige of the Association, or who shall refuse to comply with the rules of this Association, shall forfeit membership in the Association on a two-thirds vote of the Executive Committee.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8. Only members shall hold office in this Association, and only members and qualified life members shall be entitled to vote in the election of officers.

Section 9. Junior members shall be persons engaged in academic study toward a career in those areas described in Section 2 of this Article, but not currently employed in those areas. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members in Section 2 of this Article, except that they need not be recommended by a member of the Association. The term of junior membership shall be limited to five years.

ARTICLE IV

OFFICERS

Section 1. The officers of the Association shall be a president, a senior vice president, two junior vice presidents, a treasurer and nine directors, who, with the most recent past president, shall constitute the Executive Committee.

Section 2. The past presidents of this Association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the Executive Committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the Executive Committee without delay.

ARTICLE V

EXECUTIVE COMMITTEE

Section 1. The Executive Committee shall manage the affairs of the Association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the Association, and make all necessary purchases and contracts required to conduct the general business of the Association, but shall not have the power to render the Association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the Association.

Section 2. Meetings of the Executive Committee may be called by a majority of the members of the committee, providing ten days' notice is given to the executive committee by mail.

Section 3. Five members of the Executive Committee, one of which shall be either the president or a vice president, shall constitute a quorum for the transaction of business.

CONSTITUTION

ARTICLE VI

ELECTION OF OFFICERS AND SECRETARY AND TENURE OF OFFICE

Section 1. Except as otherwise provided, the officers shall be elected at the regular annual meeting of the Association and the election shall not be postponed except by a two-thirds vote of the members present at said annual meeting. The election shall be by vote, a majority of the votes cast being required for election. Any member of the Association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2. The president, two junior vice presidents, and treasurer shall hold office for one year and the directors for three years; three directors being elected each year. The senior vice president shall hold office for one year and ascend to the office of president at the expiration of such service. All officers shall retain their office until their successors are elected and installed. A director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3. The term of office of the treasurer may be terminated at any time by two-thirds vote of Executive Committee. The compensation of the treasurer shall be fixed by a majority vote of the Executive Committee.

Section 4. The secretary shall be appointed by a majority vote of the Executive Committee and the term shall terminate with the appointment of successor. The Executive Committee shall have the power, by two-thirds vote, to remove the secretary and appoint a successor at any time. The salary of the secretary shall be decided by a majority vote of the Executive Committee.

Section 5. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the Executive Committee.

ARTICLE VII

MEMBERSHIP FEE AND DUES

Section 1. Every member, upon joining this Association, shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the Executive Committee.

Section 2. A person stricken from the list of members because of non-payment of dues upon written application may be reinstated as a member in the former class of membership without loss of privileges, either upon payment of all back dues (which must accompany applications) or at the discretion of the Executive Committee voting in the manner prescribed in Section 2 of Article III.

ARTICLE VIII

LOCAL SECTIONS

Section 1. Upon the application of ten or more members of the Association residing in the same geographical district, or having offices therein, the Executive Committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this Association as the section membership may adopt and the Executive Committee approve.

Section 2. The parent Association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

(Revised July 11, 1994)

Time of Meeting

1. The regular meeting of this Association shall convene annually during the month of September, the exact date to be fixed by the Executive Committee.

2. It shall be within the power of the Executive Committee to change the time of the meeting if it becomes apparent that it is for the best interests of the Association.

Place of Meeting

3. The place of holding the annual meeting shall be determined by the Executive Committee not less than twelve months prior to the date of the annual meeting.

Quorum

4. At the regular meeting of the Association, 15 or more members shall constitute a quorum.

Dues

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:

Members, $25.00; Associate Members, $25.00; Junior Members, $25.00

Duties of Officers

6. The president shall have general supervision over the affairs of the Association. He shall preside at all meetings of the Association and of the Executive Committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. The president (or appointed Executive Committee member) shall render a detailed report at least three times during the year to the members of the Executive Committee, showing the financial condition of the Association and its activities.

At the annual meeting the president (or appointed Executive Committee member) shall present a report containing a statement of the general condition of the Association.

7. The vice presidents, in order of seniority, shall preside at meetings in the absence of the president and discharge the duties of the president in case of a vacancy in his office. The senior vice president shall have the senior position of vice presidents.

8. The secretary shall keep a correct record of the proceedings of all meetings of this Association, and of all accounts, between this Association and its members, collect all moneys due the Association, and deposit the same in the name of the Association. The secretary shall pay all bills when properly certified and approved by the president or the treasurer, and make such reports as may be called for by the Executive Committee. The secretary shall sign all contracts or other written obligations of the Association which have been approved by the Executive Committee. The secretary shall also perform such other duties as the Association may require.

9. The treasurer shall have charge of the funds, check all deposits as made by the secretary, and invest all funds not needed for current expenses. The treasurer shall report at each annual meeting on the condition of the finances.

By-Laws

(Revised July 11, 1994)

Nominating Committee

10. After each annual meeting the president shall appoint a committee consisting of five members. The most immediate past president shall act as chairperson. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual meeting in accordance with Article VI of the Constitution, said list to be read at the business session of said meeting. Nothing in this section shall be construed to prevent any member making further nominations provided that such nominations are received by the president in writing not less than thirty (30) days in advance of the first day of the annual meeting. Such nominations should be addressed to the president of the Association at its headquarters office.

Auditing Committee

11. Prior to each annual meeting the president shall appoint a committee of three members, not officers of the Association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

Orders of Business

12. The order of business at the annual meeting of the Association shall be as follows:

Call to order by president
Opening prayer or invocation
President's address
Presentation of papers, reports and special presentations
Reports of standing committees
Business Session
    Report of Secretary
    Report of Treasurer
    Report of Auditing Committee
    Report of Nominating Committee
    Election of Officers
    Necrology Report
    Unfinished business
    New business
Installation of officers
Adjournment

The order of business may be modified by the Executive Committee prior to the meeting, and is subject to change by the chair, unless protested by a majority vote of members present.

Decisions

13. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the Association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's Rules of Order.

Amendments

14. The By-Laws can be amended by a two-thirds vote of those present at any regularly called Executive Committee Meeting.

MEMBERSHIP DIRECTORY

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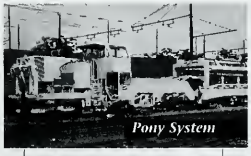

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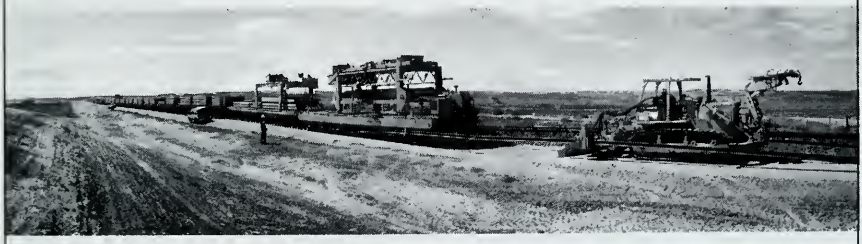

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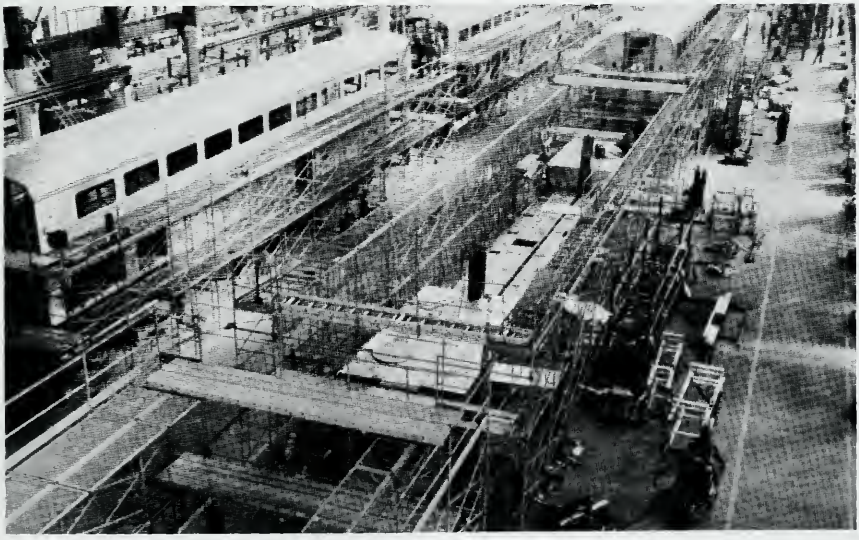

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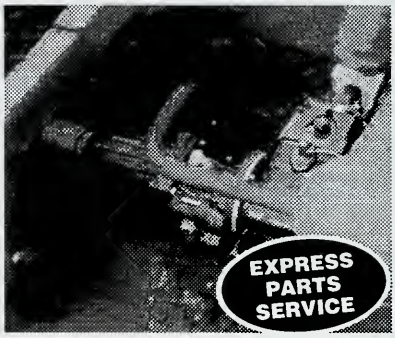

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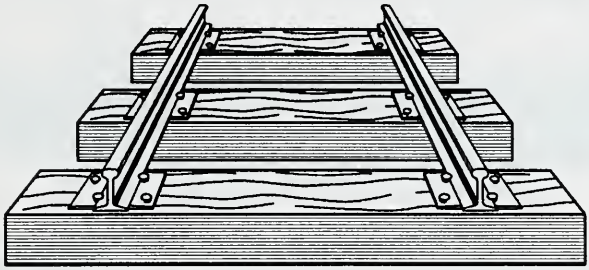

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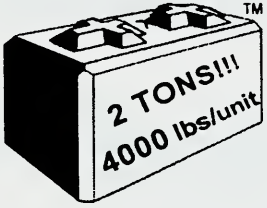

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